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"THE ENGINEER," SEPTEMBER 28, 1928.

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLVI.—No. 3794] LONDON: FRIDAY EVENING, SEPTEMBER 28, 1928 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—

Schedule 1.—INDIA-RUBBER HOSE-PIPES and OTHER FITTINGS for VACUUM BRAKE GEAR.

Schedule 2.—254 Tons SPRING STEEL.

Schedule 3.—75 Tons PILING, SHEET STEEL.

Tenders due on the 12th October, 1928, for No. 1; on the 19th October, 1928, for No. 2; and on the 2nd November, 1928, for No. 3.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 9660

Applications are INVITED by the GOVERNMENT of BIHAR and ORISSA for an APPOINTMENT as a MECHANICAL ENGINEER in the Public Health Department.

Candidates, who should preferably hold an Engineering Degree, must have had wide experience of the manufacture and maintenance of Pumping Plant. Experience in maintaining Electrical and modern Plant for Water Purification also desirable. Age between 33 and 40 years. Pay in accordance with age scale, namely, Rs. 675 a month at 33 years, rising to Rs. 1175 at 40 years, plus (for officers of non-Asiatic domicile) overseas pay of £25 a month, age 33 years, and £30 a month thereafter. Provident Fund. First-class passage for officer and wife. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 17th October, 1928. 9615

Assistant Engineer Required by the GOVERNMENT of TANGANYIKA for a period of 20 to 30 months' service in the first instance. Salary £480-20-600-30-720. An outfit allowance of £30, payable on first appointment. Free quarters, passages and liberal leave on full salary. Candidates, age 25 to 35, must have had regular training as Civil Engineers, and be Corporate Members of the Institution of Civil Engineers. Must be capable of Levelling, Surveying, Measuring-up Work, and Preparing Designs of Bridges, &c. Must have had at least three years' experience under a qualified Civil Engineer on the Construction of Harbour Works, Drainage Works, Water Supply or other Public Works.—Apply at once by letter, stating age, particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/799. 9649

Assistant Engineer Required by the PUBLIC WORKS DEPARTMENT of the GOVERNMENT of UGANDA, for a tour of 20 to 30 months' service, with possible extension. Salary £480, rising to £720 a year by annual increments. Outfit allowance of £50 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, 22 to 28 years of age, must have passed the examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting from parts "A" and "B" of that examination. Preference will be given to candidates who have had some practical experience of Civil Engineering work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1034. 9650

Safety in Mines RESEARCH BOARD. RESEARCH APPOINTMENT.

The Safety in Mines Research Board REQUIRES a RESEARCH ASSISTANT for work in connection with Wire Ropes used in Coal Mines.

Applicants must possess good scientific qualifications (preferably including a Degree in Engineering), and must be experienced Metallurgists.

Other things being equal, preference will be given to an ex-Service man.

Scale of salary, £250-15-350. In addition, a fluctuating cost of living bonus is payable, making the present minimum of the scale £353.

Forms of application, which must be returned not later than 15th October, can be obtained from the UNDER-SECRETARY FOR MINES, Establishment Branch, Mines Department, Dean Stanley-street, London, S.W. 1. 9655

The Secretary of State for INDIA will in the near future make ONE APPOINTMENT of ASSISTANT LOCOMOTIVE SUPERINTENDENT for service on Indian State Railways.

Candidates must be British subjects of about 25 years of age. They must have had a good general and technical education followed by at least three years' training in the locomotive shops of a railway company or locomotive builder of repute, and should have had six months' training in the running sheds and firing. They must also have a thorough understanding of applied mechanics and the nature and composition of all materials used in shops and should be able to design and to calculate the stresses on the parts of the machines. Some actual drawing-office experience is also desirable.

Applications must reach the India Office not later than the 30th October, 1928. Application forms and full particulars may be obtained from the SECRETARY, Services and General Dept., India Office, Whitehall, S.W. 1. 9614

Birmingham Central Technical COLLEGE.

APPLICATIONS are INVITED for the POST of LECTURER in METALLURGY. The position is a whole-time appointment, commencing January 1st next. Salary in accordance with the Burnham Scale. Full particulars and form of application may be obtained from the Principal, Central Technical College, Suffolk-street, Birmingham, to whom applications should be sent in on or before November 3rd next.

P. D. INNES, Chief Education Officer.

9626

The Engineer

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PUBLIC NOTICES

City of Cardiff Education Committee.
THE TECHNICAL COLLEGE.

PRINCIPAL - - - CHARLES COLES, B.Sc. (Lond.).

The SERVICES will be REQUIRED in January next of a FULL-TIME ASSISTANT LECTURER in ENGINEERING, qualified to teach up to Honours B.Sc. standard. The main subjects required will be those of Mechanical and Civil Engineering, but a good knowledge of Electrical Engineering will be a recommendation.

Salary payable according to Burnham Award.

Applications on foolscap paper, stating age, full qualifications, teaching and other experience, and giving copies of not more than three recent testimonials, should reach the Principal (from whom further particulars may be obtained), on or before Saturday, 13th October.

The successful candidate will be required to pass a medical examination by the Authority's Medical Examiner for Teachers at Cardiff before commencing duties, and to contribute under the Teachers (Superannuation) Act, 1925.

JOHN J. JACKSON, Director of Education.

City Hall, Cardiff. 9567

County Borough of Middlesbrough EDUCATION COMMITTEE.

CONSTANTINE TECHNICAL COLLEGE.

PRINCIPAL: DOUGLAS H. INGALL, D.Sc., F.I.C., A. Inst. P.

APPLICATIONS are INVITED for the POSITION of HEAD of the DEPARTMENT of ENGINEERING.

Salary £500 per annum, with annual increments of £25 to a maximum of £600 per annum.

Applicants are required to have had works experience in either mechanical or structural engineering in addition to possessing suitable academic qualifications.

Particulars of this appointment and form of application may be obtained on receipt of a stamped addressed foolscap envelope, and applications should reach the undersigned not later than Monday, 8th October, 1928.

W. J. WILLIAMS, Director of Education.

Education Offices, Middlesbrough, 13th September, 1928. 9556

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY CO.

The Directors are prepared to receive up to Noon on Monday, 15th October, TENDERS for the SUPPLY of:—

RED AND WHITE LEAD.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices: The White Mansion, 91, Petty France, S.W. 1. 21st September, 1928. 9606

County Borough of Croydon. EDUCATION COMMITTEE.

APPLICATIONS are INVITED for (A) TEACHER of 3rd Year MACHINE DESIGN, Tuesdays, 7.30-9.30 p.m.; (B) TEACHER of 3rd Year ENGINEERING CALCULATIONS, Mondays, 7.30-9.30 p.m. Salary 18s. per attendance of 2 hours. Particulars of technical education, practical training, teaching experience, age, and present appointments to be sent to the Principal, Central Polytechnic, Scarbrook-road, Croydon.

R. B. MORGAN, Education Officer.

9583

The Bengal and North Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

400 Pairs WHEELS and AXLES for WAGONS as per specification to be seen at the Company's Offices.

Tenders, addressed to the undersigned, and marked "Tender for Wheels and Axles," with name of firm tendering, to be lodged not later than Noon on the 17th day of October, 1928.

For each specification a fee of £1 will be charged, which cannot, under any circumstances, be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board, W. R. IZAT, Managing Director.

237, Gresham House, Old Broad-street, London, E.C. 2, 26/9/1928. 9657

PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for INSTALLING at its Abbey Mills Pumping Station, Stratford, London, E. 15, FOUR ELECTRICALLY DRIVEN CENTRIFUGAL SEWAGE PUMPING SETS, each capable of pumping 125 tons of sewage a minute against a head of 43ft., together with AUXILIARY PLANT, CAST IRON PIPING, SLUICE VALVES, a VENTURI METER, SWITCHGEAR, TRANSFORMERS, CABLES, &c.

TENDERS are also INVITED for INSTALLING, at the option of the Council, ADDITIONAL PLANT, comprising FOUR SIMILAR PUMPING SETS, &c.

The specification, form of Tender, drawings, &c., may be obtained on application to the Chief Engineer of the Council, upon payment of the sum of £5 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application, and the contract documents may be inspected before the payment of the fee.

Correspondence and remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, or, if personal application is made, applicants should apply in Room No. 3A at No. 3, Warwick House-street, Cockspur-street, London, S.W. 1, on or after Monday, 1st October, 1928.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 12th November, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX, Clerk of the London County Council.

9637

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. MILD STEEL BARS, SECTIONS, &c., for Miscellaneous Purposes.
2. METALS.
3. PIG IRON.
4. BEST YORKSHIRE IRON.
5. SPRING STEEL.
6. ELECTRIC CABLES and WIRES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked, "Tender for Mild Steel Bars, &c.," or as the case may be, with name of firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, 12th October, 1928.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the Specifications Nos. 1, 2 3 and 4, and of 5s. for each copy of the Specifications Nos. 5 and 6.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W. 1, 26th September, 1928. 9656

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for:—

(1) 1655 TONS (Approx.) STEEL MATERIAL (Comprising M.S. Channels, Angles, Flats, Squares, Plates, Sheets, &c.).

(2) 5920 GALVANISED SHEETS, PLAIN and CORRUGATED (Approx. Total Weight equals 117½ Tons).

(3) 251 TONS STRUCTURAL STEEL WORK for MILLWRIGHT SHOP (Together with Asbestos Sheeting, Patent Glazing, C.I. Piping, &c. &c.).

Tenders are due in as follows:—

Nos. (1) and (2), by 2 p.m. on Tuesday, 16th October, 1928.

No. (3) by 10.30 a.m. on Wednesday, 24th October, 1928.

Tender forms obtainable at address below; fee One Guinea each, which is NOT RETURNABLE.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices: 25, Buckingham Palace-road, Westminster, S.W. 1. 9638

Wandle Valley Joint Hospital BOARD.
TO CONTRACTORS AND DEALERS IN MACHINERY, &c.

The above Board invite TENDERS for the PURCHASE and REMOVAL of GAS ENGINE, SADDLE BOILER, ELECTRIC BATTERY, DYNAMOS, SWITCHBOARD, &c., at the Isolation Hospital, Beddington Corner, near Mitcham Junction, in accordance with the general conditions prepared by the Board's Surveyor.

Full particulars, together with forms of Tender and permit to view, may be obtained on application to the undersigned, to whom Tenders should be delivered on or before Monday, October 1st, 1928.

ROBT. M. CHART, Surveyor to the Board.

Lower Green, Mitcham, Surrey. 9550

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PUBLIC NOTICE

Waterford Harbour Commissioners.

TO CRANE ENGINEERS.

The Waterford Harbour Commissioners are prepared to receive TENDERS for the SUPPLY and ERECTION on a prepared site at Waterford of an optional HAND and ELECTRICALLY OPERATED HOISTING and SLEWING 20-TON TRAVELLING WHARF CRANE.

Copies of the outline plan and specification can be obtained on application to the Harbour Engineer, Harbour Engineer's Office, Waterford, on payment of One Guinea (£1 1s.), which will be returned in case a bona fide Tender is duly made.

Tenders must be addressed to the Chairman, Waterford Harbour Commissioners, Harbour Office, Waterford, in a sealed cover, endorsed "Tender for Crane," and must be delivered not later than One o'clock p.m. on the 19th October, 1928.

Dated this the 26th day of September, 1928.

AUSTIN A. FARRELL,
Secretary and General Manager.

Harbour Office, Waterford. 9639

Corporation of Nottingham.

WATER DEPARTMENT.

JUNIOR ENGINEERING ASSISTANT.

The Water Committee REQUIRE the SERVICES of a JUNIOR ENGINEERING ASSISTANT, not exceeding 30 years of age.

Applicants must have had a suitable training in Waterworks Engineering and Surveying.

The salary will be in accordance with Grade "B" of the City Council's Grading Scheme; gross salary £250, net £213 18s.

Forms of application may be obtained from Mr. F. W. Davies, Engineer and General Manager, Castle Waterworks, Castle Boulevard, Nottingham. Applications, with copies of three recent testimonials, must be delivered to the Water Engineer not later than Wednesday, 31st October, 1928.

W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
24th September, 1928. 9620

Institution of Gas Engineers.

The Council of the Institution of Gas Engineers is prepared to receive APPLICATIONS for the OFFICE of SECRETARY. The person to be appointed shall devote the whole of his time to the duties of his office, shall possess an intimate knowledge of the gas industry and have acquired considerable executive experience in connection therewith. Commencing salary £800 per annum.

Applications, endorsed "Secretaryship," to be forwarded to the PRESIDENT, the Institution of Gas Engineers, 28, Grosvenor-gardens, London, S.W.

Applications to be received on or before October 9th, 1928. 9571

Metropolitan Water Board.

APPOINTMENT OF A JUNIOR ENGINEERING ASSISTANT.

The Metropolitan Water Board invite APPLICATIONS from those who are Students of the Institution of Civil Engineers or have passed an examination qualifying for studentship for the POSITION of a JUNIOR ENGINEERING ASSISTANT in the Department of the Chief Engineer, at an inclusive salary of £3 per week.

Applications, in candidates' own handwriting, stating age and full particulars of training and qualifications, should be addressed to Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, and must reach the offices of the Board not later that the 8th October, 1928.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
24th September, 1928. 9622

Walsall and West Bromwich

UNIONS JOINT COMMITTEE.

GREAT BARR PARK COLONY.

WANTED, a thoroughly competent WORKING ENGINEER at the above Colony.

Candidates must have had previous experience in taking charge of Steam Plant and Electric Light Installation and be a fully competent Millwright and able to do all necessary repairs and to maintain Boilers, Pumps, Laundry, Motors, Heating Service, and Electric Light in thorough working order.

Wages £4 per week.

The successful candidate will be required to reside in a modern house on the estate, rent 6s. per week plus rates.

The appointment is subject to the provisions of the Poor Law Officers' Superannuation Act.

Application form may be obtained from me, for which a stamped foolscap envelope should be sent. Completed application forms must be received by me not later than 10 a.m. on Tuesday, the 9th October.

Canvassing members of the Committee is strictly prohibited.

By Order,
A. H. WARD,
Clerk.

22, Lombard-street, West Bromwich,
24th September, 1928. 9618

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

WANTED, ASSISTANT MANAGER for General Engineering Works, Calcutta. A knowledge of Ship Repairs an advantage. Age about 30 years. Salary Rs. 800 per month, rising to Rs. 1000 on a five years' agreement.—Write, stating age, whether married or single, to Z.A. 617, c/o Deacon's, Fenchurch-avenue, E.C. 3. 9633 A

WANTED by Leading Engineering Insurance Company, additional INSPECTORS, fully qualified in best Crane and Lift Practice. Age 28 to 32. Commencing salary £260 per annum.—Address, with full particulars of experience, age, &c., 9627, The Engineer Office. 9627 A

WANTED, Energetic Experienced TRAVELLER; must be practical engineer, with established connection outside London area, to represent firm of manufacturing engineers in Steam Engines, Woodworking Machinery, Contractors' Plant, and General Engineering Work. Resident South or South-West England. State fullest particulars, references, age, salary.—Address, 9519, The Engineer Office. 9519 A

WANTED, for Shipbuilding Establishment in Hong Kong, ASSISTANT ENGINE WORKS MANAGER. Good training in marine engine design and construction essential; also good general and technical education. Age 28-30. Give full particulars and send copy testimonials.—Address, "ENGINE," Wm. Porteous and Co., Advertising Agents, Glasgow. P4950 A

WANTED IMMEDIATELY, YOUNG ENGINEER, age 21-25, who can prove ability and willingness to take extreme care with every detail of his work. Thorough training in workshops, drawing-office and tool-room essential. Ability to make new designs, erect small plant and organise production on time-saving basis also necessary. Good remuneration and encouragement to young man with initiative and the capacity for taking great pains with everything he does.—Address fully, stating salary required, P4960, The Engineer Office. P4960 A

ASSISTANT WORKS MANAGER, About 35, Experienced in Plating, Loft Work, General shipbuilding and Repairs. Must be a practical man and used to control of men. State salary and experience, copies of references.—Address, 9641, The Engineer Office. 9641 A

CHIEF SERVICE ENGINEER for Well-established firm manufacturing Meters and Industrial Instruments for all purposes. Knowledge of Steam Generation, Power and Industrial Plant essential. Sound Electrical and General Engineering training necessary. State age, M. or S., salary required, and furnish copies testimonials. Immediate appointment, with good salary and prospects for right man.—Box M, A1773, Erwoods, Ltd., 30, Fleet-street, London, E.C. 4. 9613 A

SITUATIONS OPEN (continued)

A LEADING BRITISH ELECTRICAL MANUFACTURING FIRM WISHES to SECURE the SERVICES of a FIRST-CLASS TRANSFORMER ENGINEER. The gentleman appointed will be required to assume the full responsibility for the electrical and mechanical design, and to deal with all engineering questions connected with the largest types of transformers.

Applications, which will be treated confidentially, should state details of previous experience and the salary desired, and be sent to the office of this Journal.

The position will give every opportunity for development and scope for initiative in connection with the most important engineering schemes, and should therefore provide the essentials for an interesting and successful career for the person appointed.

Address, 9563, The Engineer Office. 9563 A

ENGINEER REQUIRED for Large Factory in the Argentine; must be of good standing and education, having had highest grade all-round technical training with subsequent experience of Steam Plant (including Evaporating and Condensing), Electrical (Direct Current), and General Mechanical Engineering. Experience of Process Working and Factory Routine also desirable. Preference will be given to a candidate having a good working knowledge of Spanish, and previous experience in South America. Permanent position with good salary and prospects for suitable man.—Applications, stating age, which must not exceed 35, salary required and qualifications, with copies of testimonials, write to "S.E.," c/o Street's, 6, Gracechurch-street, E.C. 3. 9654 A

PRACTICAL ENGINEER REQUIRED, who has specialised in the design and equipment of the latest type of Heavy Continuous Rolling Mills for the steel industry. Applicants should state age and give full details of previous experience.—Address, 9500, The Engineer Office. 9500 A

QUALIFIED ACCOUNTANT REQUIRED for Large Engineering Works in the North of England. Must be experienced Bookkeeper, with sound knowledge of Workshop Accounts.—Address in confidence, stating age, education, full particulars of training and experience and salary required, 9630, The Engineer Office. 9630 A

WANTED AT ONCE in London Office, TWO or THREE JUNIOR DRAUGHTSMEN, accustomed to detailing Steel-framed Buildings.—Address full particulars, 9619, The Engineer Office. 9619 A

WANTED AT ONCE, SENIOR and DETAIL DRAUGHTSMEN, with up-to-date Turbine experience.—Apply, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 9635 A

WANTED, DRAUGHTSMAN, Capable and Energetic, to Take Charge of small Drawing-office of Tank and Light Boiler Works in East London; must be thoroughly practical, with workshop experience preferred, and knowledge of Estimating would also be an advantage. Please send full particulars of experience, salary required, &c.—Address, 9651, The Engineer Office. 9651 A

WANTED, DRAUGHTSMEN, Thoroughly Experienced in Ore Mining Plant and Machinery.—Apply, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 9634 A

WANTED, Experienced CARRIAGE and WAGON DRAUGHTSMAN.—Apply, stating age, experience, and salary required, to CHARLES ROBERTS and CO., Ltd., Horbury Junction. 9611 A

WANTED, First-class DESIGNER, Well Acquainted with all types Bridge and Structural Designs and Quantities for large Structural Engineers in Midlands.

Address, giving full details of experience and testimonials, P5000, The Engineer Office. State age and salary required. P5000 A

WANTED, First-class DRAUGHTSMAN for Coventry district. Experienced in Machine Tool Equipment, Plant Lay-out and Operation Process.—Address, stating age, experience, and salary required, 9521, The Engineer Office. 9521 A

WANTED IMMEDIATELY, DRAUGHTSMAN, with up-to-date Pulverised Fuel experience, preferably with some experience of Structures.—Apply, stating age, experience, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith. 9636 A

WANTED IMMEDIATELY for London, Good MECHANICAL DRAUGHTSMAN, salary £5 to £6 per week.—Apply by letter, giving full particulars, including last five years, of past experience and copies of references, to "Z.O.," c/o Charles Barker and Sons, Limited, 31, Budge-row, Cannon-street, London, E.C.4. 9623 A

CHIEF DRAUGHTSMAN REQUIRED for Electric Vehicles. Application will be treated in strict confidence.—ELECTRICARS, Ltd., Lawley-street, Birmingham. P4920 A

DESIGNER and CHIEF DRAUGHTSMAN REQUIRED to Take Charge of Drawing-office in Works Manufacturing Accurate Machinery. Must have had considerable Machine Shop experience.—Address, stating age, experience, and salary required, 9539, The Engineer Office. 9539 A

DRAUGHTSMAN-DESIGNER, Experienced in Chassis Lay-out and Design of Components for Passenger-carrying Vehicles. London district. Age, experience, and salary required.—Address, 9642, The Engineer Office. 9642 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9529, The Engineer Office. 9529 A

DRAUGHTSMAN, Experienced in Designing Runways and Hand-operated Hoisting Machinery. Age about 30 years. Salary and all particulars.—Address, 9640, The Engineer Office. 9640 A

DRAUGHTSMAN REQUIRED, Accustomed Boilers, Pressure Vessels, Steam Jacketted Mixers, Self-supporting Chimneys, Buoys, Tanks, General Plate and Rolled Section Work. Good technical education. Also JUNIOR DRAUGHTSMAN, some experience same class work, for East London. State salary, age, and experience.—Address, P4997, The Engineer Office. P4997 A

DRAUGHTSMAN REQUIRED for Machine Tools, preferably one used to Rolling Machinery. State age, wages, experience, &c.—Address, P4986, The Engineer Office. P4986 A

DRAUGHTSMAN REQUIRED for Mechanical Handling Machinery; only first-class men, capable of developing schemes need apply. State experience, age and salary required.—Address, 9581, The Engineer Office. 9581 A

DRAUGHTSMAN REQUIRED, One with Knowledge of Machine Tool Design and Automatic Work essential. None others need apply. Salary £4 10s. per week.—Address, stating age and experience, 9560, The Engineer Office. 9560 A

DRAUGHTSMAN REQUIRED, with Experience in the Design of Heavy Motor Vehicles. State age, experience and salary required.—Address, 9653, The Engineer Office. 9653 A

DRAUGHTSMAN REQUIRED, with Rolling Stock and Tramcar experience. London district. State age, salary, and experience.—Address, 9644, The Engineer Office. 9644 A

FIRST-CLASS STRUCTURAL DRAUGHTSMAN WANTED for Temporary Work in Kent. Good salary paid to suitable man.—Address, stating age and salary, 9609, The Engineer Office. 9609 A

FULLY Experienced AERONAUTICAL DRAUGHTSMEN REQUIRED.—State full particulars and salary required to THE BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 9646 A

GOOD DRAUGHTSMEN REQUIRED for Manchester Civil Engineers' Office. State experience, age, and salary required.—Address, P4984, The Engineer Office. P4984 A

SENIOR DRAUGHTSMEN WANTED for Steam Turbine Details; also for Steam Power Station Lay-out.—Write, stating age, training, experience, salary, and date free, to CHIEF DRAUGHTSMAN, English Electric Co., Ltd., Rugby. 9645 A

STEEL WORK DETAIL DRAUGHTSMAN WANTED IMMEDIATELY; only first-class considered.
FAIRWEATHER and RANGER, 18, Brownlow-street, Holborn, W.C. 1. P4990 A

STRUCTURAL ENGINEERING DRAUGHTSMEN REQUIRED in a London office for the design of Steel-framed Buildings and other Structural Steel Work. A knowledge of Reinforced Concrete Design will be considered an advantage.—Write, furnishing age, particulars of training and experience, and salary required, to "C.T.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 9632 A

STRUCTURAL STEELWORK.—DRAUGHTSMEN REQUIRED in London district, with experience in Detailing work. Good prospects for suitable men.—Write, giving particulars of experience, age, salary required, 9659, The Engineer Office. 9659 A

TOOL DRAUGHTSMAN WANTED, Used to Small Parts. State experience, salary required, and age.—Address, 9643, The Engineer Office. 9643 A

TWO JUNIOR DRAUGHTSMEN REQUIRED, experienced in Jig Drawing-office, for large works 30 miles from London; Shop experience essential.—Address, full particulars of experience, salary expected, and when at liberty, 9648, The Engineer Office. 9648 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

A Reconditioned Cross-Channel Steamer.

THE recent departure of the steamer "Gibel Dersa" from Vickers-Armstrongs' yard at Barrow for Gibraltar, where she will take up service between that port and Tangier, marks a further useful phase in the life of a well known Cross-channel boat. As the "Duchess of Devonshire" the same steamer has seen useful service between West Coast ports and Belfast and the Isle of Man. She has a length of 300ft. between perpendiculars, with a breadth of 35ft., the designed deadweight capacity being 430 tons on a draught of 11ft. 6in. Although the ship was built at Barrow in 1897, her propelling machinery, which comprises two triple-expansion engines and double ended cylindrical boilers working under forced draught, was shown to be as efficient as ever, enabling the original speed performance of about 18 knots to be repeated on her recent trials. New public room accommodation, including a lounge, smoking-room and ladies' cabin has been added, and new quarters for the officers and engineers have been built. The sub-division of the hull has been increased by adding two extra bulkheads and a water-tight flat, while the new life-saving equipment and wireless outfit make the vessel conform to the home standard regulations of the Board of Trade. The "Gibel Dersa" is now owned by M. N. Bland and Co., and the alterations have been carried out by Vickers-Armstrongs, Ltd., under the supervision of the owners' marine superintendent, Mr. A. G. Scullard.

Heavy-Oil Engines for Aircraft.

THE 650 horse-power heavy oil Beardmore "Tornado" engines with which the Government airship R 101 is being fitted will not after all represent the first installation in aircraft of engines working with fuel of a high specific gravity and high flash point. A report received during the past seven days from Detroit states, on the authority of the Packard Motor Company, that successful test flights have been carried out on an aeroplane fitted with an engine of the Diesel type. The engine, designed by Captain Woolson, is of the radial air-cooled type and develops 200 horse-power. It is stated to have fewer parts than the lightest petrol aero-engine made. Its use will, it is claimed, reduce the consumption of fuel and the cost of the fuel. It is stated that with the same weight of fuel on board the aeroplane will fly 25 per cent. farther than it would if fitted with a petrol engine. In addition to a reduction of the risk of fire, the engine will possess the advantage of facilitating wireless communication to and from the aeroplane by cutting out the interference caused in a petrol machine by the electric ignition system. The weight of the engine is given as being less than 3 lb. per horse-power. It would therefore appear to be about twice as heavy as a radial air-cooled engine of the same power using petrol. Further tests of the engine are to be made before it is produced for sale.

The National Fuel and Power Committee.

THE first report of the National Fuel and Power Committee was published at the end of last week. This Committee, over which Lord Melchett presides, was appointed in August, 1926, by the President of the Board of Trade to advise upon questions concerned with the economic use of fuels and their conversion into various forms of energy. In its first report the Committee deals almost exclusively with coal and its derivatives. The importance of research aiming at improvements in the present methods of using fuel is emphasised, but the fear is expressed that if such research were carried out on the scale which is its due there would be an insufficiency in the supply of men of ability who have specialised in the work. Dealing with the use of low-grade fuel, the Committee discusses its use at the pit-head for the generation of electrical power, but points out that the determination of the sites for future capital power stations is in the hands of the Central Electricity Board, and that the cheap price of low-grade fuel in a colliery district does not necessarily make it desirable that electricity for general public supply should be generated there. The gas industry as a whole is described as progressive and efficient, but the coke oven industry is considered to be below the requisite standard. Reorganisation of coke oven plants as soon as possible is advocated. In that connection the Committee advances the interesting suggestion that within the confines of a limited area the Government should carry out an experiment on the distribution of coke oven gas through a network of gas mains on the lines of the national electricity "grid" scheme. Suggested areas are those between Liverpool and the Humber and between Leeds and Birmingham.

The Anglo-French Naval Accord.

THE substance of the recent Anglo-French naval compromise has now been disclosed. The two Powers, it appears, have come to an understanding on certain points relevant to the distribution of naval strength. France has at last agreed to accept the British method of assessing fleet values by ship categories, instead of by total tonnage, the formula to which she had hitherto adhered. She has further adopted the British view with regard to cruisers, viz., that vessels above 6000 tons, mounting 8in. guns, should be rationed more strictly than ships of 6000 tons or less, mounting 6in. guns. In return, the British Government has seemingly withdrawn its opposition to the non-restriction of submarines of the coast defence class, a rating which, in French opinion, should be applied to all boats below 600 tons. It will be observed with some surprise that France associates herself with the American thesis that mercantile ships should be considered when estimating sea power. The idea that armed liners should be reckoned the equivalent of regular naval cruisers was rightly termed "a landsman's idea" by Lord Jellicoe at last year's Geneva Conference. It goes without saying that this informal accord with France will be of practical value only in the event of its being approved by the other signatories to the Washington Treaty. That is so obvious that the outcry which has been raised in the United States has caused genuine surprise in this country. Washington advices indicate that the naval authorities there are adamant in their resolve to build nothing but 10,000-ton cruisers. It seems, however, incredible that this purely technical factor will be allowed to remain an obstacle in the path of further naval limitation.

The South-East England Electricity Scheme.

CONTRACTS amounting in value to about one million pounds have been placed by the Electricity Board for the construction of 132,000-volt transmission lines in the area of the South-East England Electricity scheme. The work associated with the first portion of the scheme, which covers the northern part of the area, has been placed in the hands of the General Electric Company, whilst that associated with the second portion, covering the southern part of the area, has been placed with Callender's Cable and Construction Company, Ltd. The South-east England Electricity scheme, it will be remembered, is designed to supply an area with a population of over 11,000,000, and under the estimates adopted by the Central Electricity Board earlier in the year, capital expenditure on transmission lines and generating stations will by 1933–1934 have amounted to more than £12,000,000. The area embraced includes London and the counties of Middlesex, Hereford, Essex, Kent, Surrey, Berks, Buckingham, Bedford, Cambridge, and Huntingdon, with parts of Sussex, Hants and Suffolk. The present consumption of about 112 units per annum per head of population is expected to increase to 265 units in 1933–1934, and to 426 units in the year 1940–1941. Within the area there are at present 165 authorised undertakers owning between them 135 stations, but ultimately the area will be supplied by eighteen capital stations, thirteen of which are already in existence, while two are projected, and the remaining three will be quite new.

The Late Sir Horace Darwin.

THE death of Sir Horace Darwin, F.R.S., which occurred at his home in Cambridge on Saturday of last week, September 22nd, removes from our midst one who in his time exercised a very considerable influence on the progress of experimental science. He was born in May, 1851, and was a son of Charles Darwin, the famous evolutionist. With his brothers George and Francis, he was a Fellow of the Royal Society, and it is said that in that fact the family established a record unrivalled by any other. Sir Horace was educated at Trinity College, Cambridge, and graduated in 1874 with honours in the Mathematical Tripos. In 1880, in company with Mr. A. G. D. Smith, he established a small workshop in Cambridge for supplying scientific workers with instruments made under the supervision of men who themselves were scientists. The undertaking eventually grew into the Cambridge Instrument Company, whose products are of world-wide repute, and over which Sir Horace presided as chairman. During the war Sir Horace was a member of the Munitions Inventions Panel, and served as chairman of the Air Inventions Committee. In 1913 he gave the first Wilbur Wright Memorial Lecture before the Royal Aeronautical Society, his subject being "Scientific Instruments: Their Design and Use in Aeronautics." Outside his scientific work he took much interest in the affairs of Cambridge. In 1896–7 he served as Mayor of the town, and in 1919 was a member of the Royal Commission on Oxford and Cambridge Universities.

Extensions at the Huddersfield Power Station.

ON Wednesday, September 26th, two new turbo-generating sets, built by the English Electric Company, were put into operation at the Huddersfield power station. Each set has a normal output of 6000 kilowatts, and runs at a speed of 3000 revolutions per minute. The turbine-room now contains 23,500 kilowatts of steam turbine plant, the whole of the modern plant consisting of English Electric machines. The boiler-house has also been remodelled and brought into line with present-day practice. It contains thirteen Stirling water-tube boilers, capable of generating collectively 380,000 lb. of steam per hour. A refuse destructor plant of the latest Woodall-Duckham type, capable of producing 48,000 lb. of steam per hour, is now being installed. The new generating sets have naturally called for new switchgear, which has been supplied by the Metropolitan-Vickers Company. The condensers for the new turbines which have two cylinders arranged in tandem, were supplied by Hick, Hargreaves and Co., Ltd. From the time of its inception in 1893, the undertaking has proved successful Not only has the business increased, but the working expenses have also steadily diminished. More than four times the quantity of electrical energy is now obtained from a pound of coal, than was obtained in the year the station was opened. Moreover, the total capital expenditure on the station is less than £12 per kilowatt. Originally, the station contained three vertical engines, driving Mordey single-phase alternators, but the modern generators produce 50-cycle three-phase current at a pressure of 6600 volts. The working steam pressure is only 200 lb. per square inch.

The Whitworth Scholarship Awards.

WITHIN the last few days we have received from the Board of Education the list of awards made on the results of the 1928 competition for Whitworth Senior Scholarships and Whitworth Scholarships. There were ten competitors for the Senior Scholarships, of an annual value of £250 tenable for two years. Two awards were made, one to a Wigan draughtsman and the other to a mechanical engineer at Falkirk. Fifty-five competitors entered for the Scholarships, which are valued at £125 per annum, and are tenable for three years. As in previous years, by far the largest number of awards have been made to apprentices at the Royal Dockyards. There were three awards made to Chatham apprentices, one to a Portsmouth apprentice, and one to a Devonport apprentice; while two others were made to apprentices at Manchester and Sunderland. Whitworth prizes of the value of £10 each were awarded to twenty-five unsuccessful competitors for the Scholarships. Of these prizes, fifteen went to competitors from Chatham, Devonport, Portsmouth, and Sheerness dockyards, two to Swindon apprentices, two to Woolwich apprentices, one to a Post Office probationary inspector, one to a Horwich fitter, one to a Gateshead apprentice, one to an electrical apprentice at Sittingbourne, one to a Halifax millwright, and one to a Sunderland apprentice. An analysis of the actual monetary distribution shows that a total of £2055 was gained by competitors from Government establishments and £1820 by competitors in all other parts of the country.

French Aviation.

THE Air Ministry was created in France before any attempt had been made to define its functions, and the newly appointed Minister is now endeavouring to find out where his authority begins and ends. He wants to centralise the services in his own hands, but he is opposed by his naval and military colleagues. In this struggle for centralisation the Minister for Air has the support of public opinion, which believes that there can be no progress in aviation unless it is under the control of a man who is at the same time an air expert and an organiser. The office was created with the object of putting an end to abuses from which French aviation is alleged to be suffering. There are no fewer than thirty-four manufacturers in the aeroplane industry, the great majority of whom live on the subsidies paid by the four services that control naval, military and civil aviation. It is argued that so long as the creation of types is left in the hands of the military and naval authorities the machines will necessarily be designed for their special needs and will be quite unsuitable for commercial purposes. The notorious failures of machines in the past are said to be due to a lack of co-ordination and to the existence of so many firms which have not the means or the ability to keep themselves in the van of aviation progress. It is therefore proposed to withdraw subsidies from all the small firms and to leave the work in the hands of a few makers who have shown initiative in building and improving trustworthy machines. The object of the Air Minister is to adopt the British system of centralisation, while the Minister of Marine is especially insistent upon the navy having control over its own air service. It is probable that the discussion will end in a compromise which will be more or less satisfactory to both sides.

Marine Engine Types.

AT the present time there are in the erecting shops of the Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, representative installations of the four leading types of marine propelling machinery. Single reduction geared turbines for H.M.S. "Norfolk," twin-screw eight-cylinder two-cycle Fairfield-Sulzer engines for the Bibby liner "Staffordshire," and triple-expansion steam engines for the C.P.R. steamship "Princess Norah" are being completed; while the turbo-electric machinery for the P. and O. liner "Viceroy of India," built by Alex. Stephen and Sons, Ltd., is being put aboard by the 250-ton crane.

Machine Tool Exhibition, Olympia.

No. IV. (*conclusion*).*

THE fourth Machine Tool and Engineering Exhibition at Olympia closed on Saturday of last week. In what follows we conclude our account of some of the principal exhibits.

JAMES ARCHDALE AND CO., LTD.

Among the numerous milling and drilling machines exhibited by James Archdale and Co., Ltd., of Birmingham, two stood out conspicuously by reason of their entirely new design. These machines were the 28in. all-geared horizontal milling machine illustrated in Fig. 69 and the 5ft. 9in. heavy-duty, centralised control, radial drilling machine shown in Fig. 70.

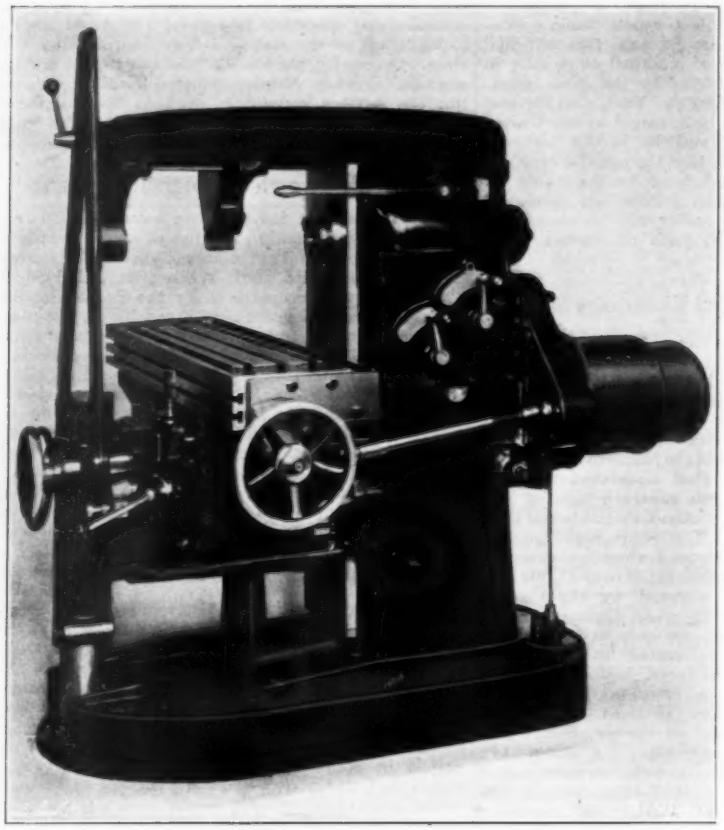


FIG. 69—ALL-GEARED HORIZONTAL MILLING MACHINE—ARCHDALE

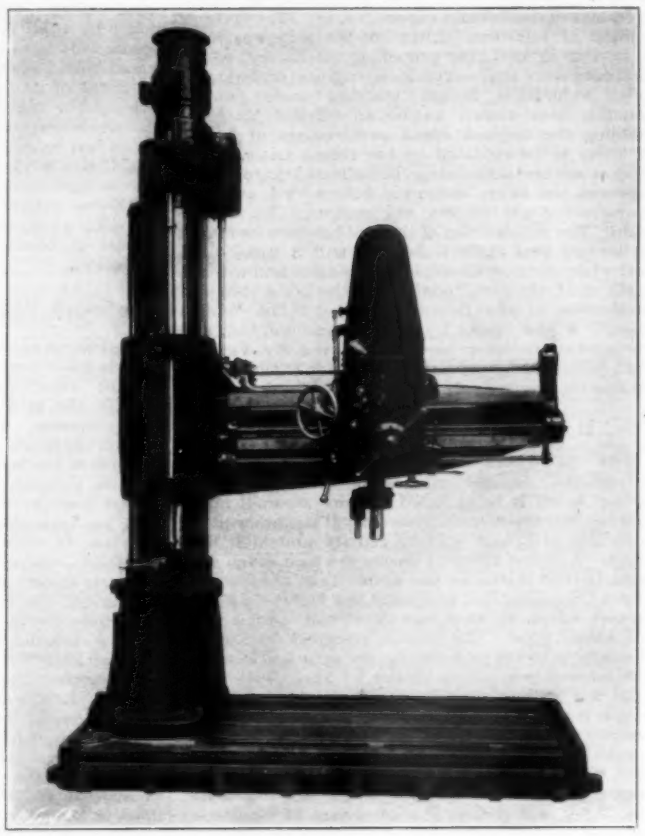


FIG. 70—HEAVY DUTY RADIAL DRILLING MACHINE—ARCHDALE

The horizontal milling machine—Fig. 69—is driven by a 6 H.P. flanged motor attached to the rear of the column. From the motor, the drive is transmitted to the spindle through a six-speed change gear-box. All the gear wheels in the main transmission are hardened and ground, and are mounted on ground solid spline shafts running in ball bearings. The spindle is case-hardened and ground, and bored to the new standard taper adopted by the leading British and American manufacturers. It is mounted in Timken taper roller bearings, the front housing carrying two opposed adjustable bearings. The six spindle speeds range from 30 to 460 r.p.m. A four change feed-box of the selective sliding gear type is mounted on the head, the gears being hardened. In addition, the feed range can be extended by means of hardened steel slip gears. Two pairs of slip gears in conjunction with the change feed-box give a total of sixteen feeds, ranging from 1in. to 12in. per minute. The lubrication of the machine is provided for by means of an oil pump within the machine, which is readily removable without disturbing the pipe joints. The feed drive is by means of a large diameter universal jointed shaft, the joints being hardened. Both longitudinal, transverse, and vertical power traverse are provided, whilst a special arrangement of trips allows of intermittent cutting, and gives rapid traverse over gaps in the work, with a quick-return motion to the table. The outer steady of the knee is of a recently patented form, which comprises three parts telescoping one within the other. One piece is fixed to the base plate, another is fixed to the knee, and the third slides between these two. All three are geared together by two racks and a pinion in such a manner that the intermediate piece moves at half the speed of the top piece, and consequently maintains a good bearing between the several parts. A clamp is provided for fixing the steady. The deep pan type base gives a good support to the machine. It has a large coolant holding capacity, and the upper surface largely consists of a number of loose perforated plates, which allow the coolant to drain into the sump, and greatly facilitate cleaning. The coolant is supplied to the cutter by means of a centrifugal pump arranged below the level of the sump, so as to be self-priming. It is driven by a light torque bar from the motor bracket, which permits of ready disconnection of the pump for cleaning or when not required.

The drilling machine shown in Fig. 70 is an entirely new machine, and embodies a number of new and improved features. It is designed for high-speed, heavy-duty drilling, and will drill holes up to 3in. diameter in mild steel. It has a working radius of 5ft. 9in. The pillar and sleeve are of exceptionally rigid form, the sleeve being 18in. diameter and mounted upon annular roller bearings at the top and bottom of the pillar. The sleeve is accurately ground to a "glass finish," as is also the arm bearing, to ensure a good sliding fit. The machine is driven by means of a 7½ H.P. vertical direct-current flanged motor at the head of the pillar running at 2800 r.p.m. The whole of the speed and feed change mechanism is mounted in the saddle, and all the control levers, except the combined arm lock and elevating lever, are within easy reach of the operator from his working position. The spindle is of heat-treated high-carbon steel, 2¼in. diameter, and of solid six-splined form, accurately ground on the splines. It is mounted in a heat-treated steel sleeve and rotates in ball bearings, with ball thrust washers at the top and bottom. The feed rack is cut in one with the sleeve and the feed rack pinion is of heat-treated chrome vanadium steel. The spindle is balanced by means of a compensated spring, fully enclosed and protected against the ingress of dirt. The spindle speeds are obtained through a gear-box on the saddle, giving in conjunction with the double gear change on the spindle a total of twelve speeds. The speed ratio in the gear-box is about 35/1, but it may be reduced by a high-speed drilling attachment in the ratio of 2·7/1. Twenty-four speeds are available when the attachment is mounted, the range being from 21 to 750 r.p.m. The speed and feed gear-box shafts are of solid six-splined form, and ball bearings are used throughout the main transmission. Six rates of feed are obtainable through a quick-change feed-box mounted on the saddle. The gears in the change speed-box are hardened, and ground on the teeth, whilst the feed gears are also hardened. The speeds are obtained by means of a "joy-stick" movement of a single lever supplemented by the double gear lever. The six rates of feed range from 32 to 1620 c.p.i. In addition to the power feed, a sensitive feed controlled by the same lever is supplied, and there are also a fine hand feed and quick hand traverse.

A single lever on the saddle unlocks the arm from the sleeve and simultaneously engages the elevating motion, thus rendering it impossible to engage the elevating clutches with the arm locked to the sleeve. In addition, safety trips are provided at the top and bottom of the pillar to prevent damage through over-traversing the arm, and a safety nut is provided on the elevating screw to prevent any possibility of the arm dropping if the elevating nut should fail. The saddle is mounted upon rollers, and has hand and power traverse along square-edged guide ways on the radial arm. Both the hand and power traverses are controlled by the same hand wheel. The saddle mechanism is lubricated by means of pump circulation, a "Purolator" oil filter is mounted at the rear, and visible oil level indicators are provided at both front and rear of the saddle. The saddle is locked on the arm, and the arm on the sleeve simultaneously, by the movement of a single lever on the saddle. The sleeve lock is operated electrically by means of a simple solenoid operating a toggle mechanism, the solenoid being housed in the column. When alternating current only is available, this electric lock is operated by means of a ⅓ H.P. high torque polyphase motor, connected by spur and worm reduction gears to the clamping excentric.

HOLBROOK AND SONS.

Several machines of the tool-room variety were exhibited by Holbrook and Sons, 44–46, Martin-street, Stratford, E. 15. Among them was the tool-room lathe illustrated in Fig. 72. This machine can swing a diameter of 13in. over the bed and can accommodate lengths up to 24in. between its centres. Its headstock spindle is fitted with a four-stepped belt pulley. Back gearing and a two-speed countershaft give a range of sixteen spindle speeds extending from 14 to 550 revolutions per minute. A brake is fitted to act on the flange of the belt pulley adjacent to the largest step and enables the spindle to be stopped quickly. A quick-change gear-box of the sliding pinion variety permits threads from 1¼ to 80 per inch to be cut and corresponding sliding and surfacing feeds to be applied. The leading screw, corrected from a master screw of high accuracy, is used only for screw cutting, the sliding and surfacing feeds being transmitted through an independent spline shaft. A

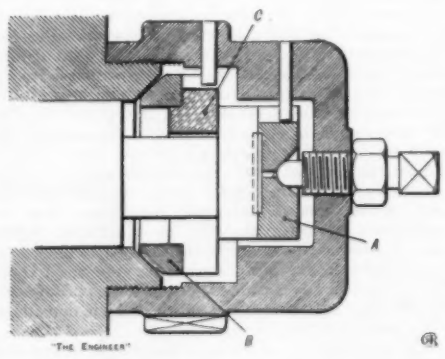


FIG. 71—COMPENSATING THRUST BEARING

* No. III. appeared September 21st.

patented compensating thrust, illustrated in Fig. 71, is fitted to the right-hand end of the leading screw. In the ordinary way the thrust of the leading screw would be transmitted from a collar on it near its end to the abutting face of the supporting bearing. Slight inaccuracies in the planeness of the abutting faces would cause the leading screw to move to and fro axially or to "whip," and in either case a periodic error would be generated in the thread cut on the work. In the Holbrook compensating bearing the end of the leading screw abuts against a phosphor-bronze washer A which is free to swivel about a ball-pointed set screw which may be adjusted to take up wear. The disc is prevented from rotating by means of a pin engaging with a cut in its edge and consequently all wear occurs between the end of the leading screw and the face of the disc and none on the point of the ball-ended set screw. The thrust in the opposite direction is taken by a spherical-faced washer B abutting against a 45 deg. coned seat in the leading screw supporting bracket. This washer B is slipped over the end of the leading screw and is held in position by means of a horseshoe washer C which is passed on to a neck near the end of the leading screw, and which is prevented from rotating by means of a retaining pin. The sliding and surfacing feeds are engaged and disengaged through triggers on the apron and cannot be engaged when the screw-cutting feed is in use. A reversing lever on the apron reverses the feeds through the agency of a separate shaft extending into the gear-box. The travel of the tool carriage can be limited in either direction by means of automatic stops on a horizontal shaft. The position of these stops on the shaft is roughly adjusted to the requirements of the work. A fine adjustment of the knock-off point is obtained by means of a graduated dial on the apron, which advances or retracts by steps of a thousandth of an inch a sleeve which surrounds the shaft and which effects the knock-off movement when its ends make contact with the stops. An additional micrometer stop is fitted at the left-hand end of the front shear of the bed. This stop is intended to be used when the sliding feed is applied by hand and does not automatically interrupt the feeding movement.

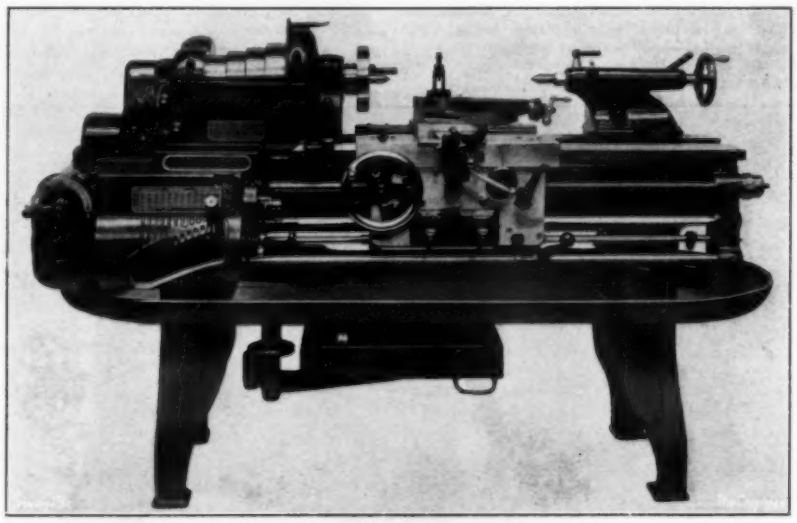


FIG. 72—TOOL-ROOM LATHE—HOLBROOK

H. W. KEARNS AND CO., LTD.

Of the machines shown on the stand of H. W. Kearns and Co., Ltd., Broadheath, near Manchester, the most interesting and novel was the axle-box boring and facing machine, which we illustrate in Fig. 90 on page 346. This machine is fitted with two heads carrying tools whereby the two sides of the axle-box may be faced simultaneously, and the edges of the bore radiused. The axle-box keep may be fixed in position during this operation, and may be faced simultaneously with the box. The left-hand head, in addition to the facing and radiusing tools, carries a boring snout fitted with four tools. Of these tools, three are employed for boring the box to size, one of the three having a fine micrometer adjustment for taking the finishing cut. The fourth tool is provided with an excentric motion which causes it to move radially in and out as the snout rotates. The maximum projection of the tool from the surface of the snout occurs when the tool is at twelve o'clock, and the maximum withdrawal when it is at six o'clock. The effect is that the fourth tool bores the work about a centre which is raised above the centre about which the three other tools act. The axle-box is presented to the tools with the keep uppermost, and consequently the fourth tool operates principally on the keep. Its cut may extend beyond the limits of the keep, but in any event the tool is out of action in the six-o'clock position and for a certain extent on each side of that position. This arrangement, known as the "Jhansi" system, from the Indian locomotive works where it was first developed, enables the required amount of clearance to be given to the bore of the box over the keep and on each side of it simultaneously with the machining of the main bore. The amount of clearance and the degree to which it should extend round the bore are matters concerning which individual railways have different standards. To meet various requirements, two excentrics are provided with the machine, which, in conjunction with the means fitted for adjusting the "throw" of the fourth tool, cover the full range of possible clearances. The boxes are lifted on to the work table by means of a 5 cwt. overhead electric hoisting arm, forming a self-contained part of the machine. The work table slides transversely, and is fitted with a rapid setting motion. While one box is being machined another is being placed in position on the table, and when the first is finished the second can be quickly moved into the machining station. Each box is carried on the table on an independent jig, comprising gripping jaws and a double wedge base. The tools are provided with reversible automatic feeds and self-acting knock-off motions. The machine can face diameters up to 24in. There are six changes of facing speeds, ranging from 10 to 60 r.p.m., and four reversible facing feeds ranging from 8 to 64 cuts per inch. Four feeds covering the same range are available for the horizontal movement of each headstock, the total horizontal movement provided for being 18in. The rapid cross adjustment of the table covers a distance of 48in.

DEAN, SMITH AND GRACE, LTD.

The 7in. electrically-driven tool-room lathe—illustrated in Fig. 88, page 346—formed a noteworthy exhibit on the stand of Dean, Smith and Grace, Ltd., Keighley. Rear and end views of this machine are given in Figs. 73–75. The lathe has been designed to embody the whole of the electrical equipment within its own compass. The motor is of 3 H.P., and is of the reversing type. It is bolted by a large flange to the end of the bed, and drives through a helical toothed pinion enclosed within the machine. The control gear for the motor is housed inside the pedestal beneath the headstock, the starting and reversing panels being bolted to the backs of the two doors. When these doors are opened the panels are brought into an accessible position. The act of opening the doors trips the main switch at the back of the pedestal compartment, and, as a result, the control gear is rendered "dead" as soon as it is exposed. The main switch can be independently operated from an external knob without opening the doors. In normal working the machine is started, stopped and reversed by means of three push buttons on the front of the headstock. The control is such that if the machine is running forward the reverse button is non-effective until the stop button has been pressed and *vice versâ*. The construction of the headstock is claimed to be novel. The fast-running shafts and gear wheels are carried in a box inside the bed in a manner which avoids excessive overhanging at the back of the headstock, and which helps to keep the centre of gravity of the machone low. There are

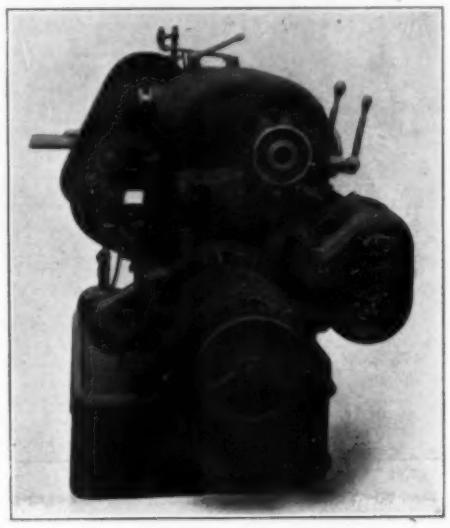


FIG. 74—TOOL-ROOM LATHE, HEADSTOCK END

twelve spindle speeds ranging from 8 to 371 r.p.m., which are obtained through sliding gears and a toggle clutch. The use of a friction clutch on the slow running shaft, in spite of theoretical arguments against it, has been retained by the designers because of its ease of operation and because of the convenience with which it gives by a single movement of its lever a big change in speed ratio without shock. The clutch handle has two stations, the sliding gear handle alongside it three, and the sliding gear handle on top of the casing two. On the fast-running shaft provision is made for speeding up the follower gear by frictional means, so that the wheels may be meshed without shock. The feed change gear-box is of the quick-change tumbler type, giving twenty slid ng and surfacing feeds, and forty screwing feeds by means of a 10-step tumbler, a two-speed handle and two reversible gear wheels. Special threads can be cut by applying change wheels to a quadrant. The feeds can be

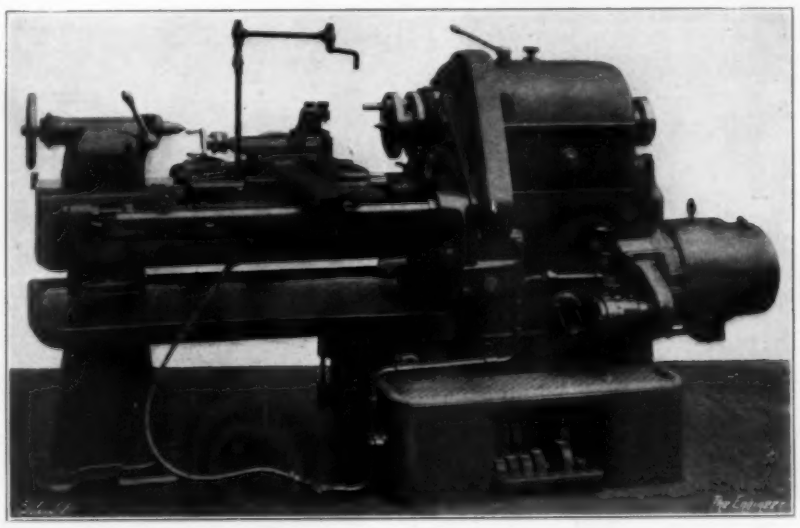


FIG. 73—REAR VIEW OF TOOL-ROOM LATHE—DEAN, SMITH AND GRACE

reversed by the movement of a shaft passing through the saddle. This shaft is fitted with knock-off dogs, which can also be used as dead stops. A taper turning arrangement is fitted to the tool cross slide at the rear of the bed. It consists, as shown in Fig. 75, of a guide bar, which may be set over by a screw adjustment to an inclination either way with the main shears of the bed. With this bar a block beneath the cross slide engages. The cross slide is fitted with a swivelling rest, and to this rest a relieving move-

ment may be applied to deal with a varying number of flutes from two upwards. The relieving movement is derived from a cam operated by gearing inside the headstock. The throw of the movement can be altered by changing the cam and the number of reliefs per revolution of the work by varying the gear ratio. The relieving movement is combined with the taper turning attachment in such a way that the relief can be cut over the diameter, sideways or at any angle. The leading screw is reserved solely for screw cutting, the sliding and surfacing feeds being transmitted from the gear-box to the saddle by means of a spline

FIG. 75—TOOL-ROOM LATHE, TAILSTOCK END

shaft. It is impossible to engage any two of these feeds simultaneously. Should it be desired to drive the machine by belt a bracket can be bolted to the bed in place of the motor to carry a pulley with which is combined a friction clutch. The machine will admit 2ft. 4½in. between its centres, and can swing 14½in. over the bed.

BERTRAM THOMAS.

The storing rack which is illustrated in Fig. 76 is one of a variety of forms which were exhibited by Bertram Thomas, of Worsley-street, Hulme, Manchester. The constructional details of these racks, to which the name of "Tiltrack" has been applied,

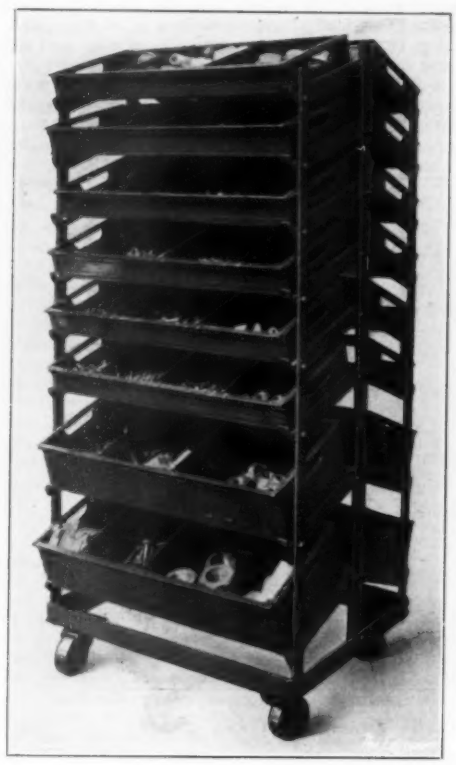


FIG. 76—STORING RACK—THOMAS

are fairly obvious from the illustration, from which it will be gathered that they are made of steel throughout. The broad principle is to build up a rack of a series of standard sections, so that it can be conveniently extended or altered without disturbing the whole arrangement. The trays for holding the goods are held at a slight angle, which makes their contents easily visible, while it facilitates taking down the trays from the racks. For subdividing the trays standard partitions are provided, which can easily be slipped in place, while for very small parts honeycomb containers that can be lifted out are used. The whole system seems to have been carefully thought out so as to make it as adaptable and convenient as is possible.

THOMAS WHITE AND SONS, LTD.

One of the noteworthy features about the woodworking machines which were shown on the stand of Thomas White and Sons, Ltd., Paisley, was the almost entire absence of belts for driving purposes. Instead, each machine was equipped with its own motor, and in some cases with more than one motor. A planer, for instance, had half-a-dozen motors, one being provided for each spindle and coupled directly thereto.

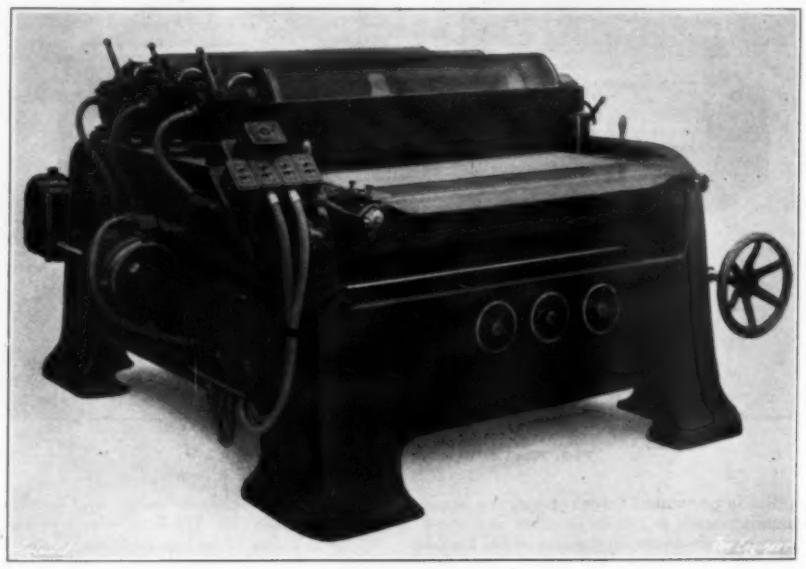


FIG. 77—SANDING MACHINE—WHITE

The electric connections were encased in flexible metallic tubing and branched out from a central distribution box. In the case of the sanding machine illustrated by Fig. 77 the three motors are arranged right inside the three rolls, so that they are well protected and out of the way. The paper is put on these rolls in a spiral form, so that there is no perceptible jolt as the joint passes over the work. The paper can be changed in five minutes. There were also on this stand a dovetailing machine and a panel planing machine.

CRAVEN BROTHERS (MANCHESTER), LTD.

The exhibits shown on the stand of Craven Brothers (Manchester), Ltd., Vauxhall Works, Reddish, Stockport, represented a selection of the products of the amalgamated firms of Craven Brothers (Manchester), Ltd., Sir W. G. Armstrong, Whitworth and Co., Ltd. (Machine Tool Department), Joshua Buckton and Co., Ltd., and Thomas Shanks and Co., Ltd. Craven Brothers only recently became members of the Machine Tool Trades' Association, and, consequently, very little space was then available at Olympia, and it was consequently found possible to exhibit only a small proportion of the heavy railway works plant and machinery of all descriptions in course of construction in the works at Reddish.

The axle turning lathe shown in Fig. 78 is suitable for turning axles of locomotives, carriages and wagons by means of multiple tools. The machine is very robust in construction, and is capable of taking heavy cuts with a total of anything from eight to twelve roughing tools cutting simultaneously. Multiple tools are employed for roughing and finishing cuts, while forming blades may be used for finishing the journals which can be finally burnished by a single roller on each rest. The central headstock is driven by double helical gears, and is fitted with a flexible driving chuck for gripping the axle. The lathe is provided with automatic trips to the longitudinal traverse, and dead stops for diameter and quick power traverse to the saddles.

A standard British 12-ton wagon axle having ¼in. excess diameter to be removed can be rough-turned and finished complete from the forging in 45 minutes, floor to floor. A continuous output of ten standard British 12-ton wagon axles can be obtained per day of eight hours, finished complete from the forging. For such a performance the limit of material to be removed is ¼in. on any diameter. An ordinary straight steam locomotive axle can be roughed and finished in about 90 minutes, floor to floor, including the forming of the wheel seats and journals and the burnishing of the journals, but not including any work upon the middle part of the axle. The cutting capacity of this machine is six cuts, each ¼in. deep by ⅛in. feed at 60ft. cutting speed per minute, employing a 35 H.P. motor. A total of 67¼in. cubic inches of metal may be removed per minute. The height of the centres is 15¼in., and the length between centres 8ft. 3in.

The machine shown in Fig. 91, page 346, is intended for turning motor car back axles and crank

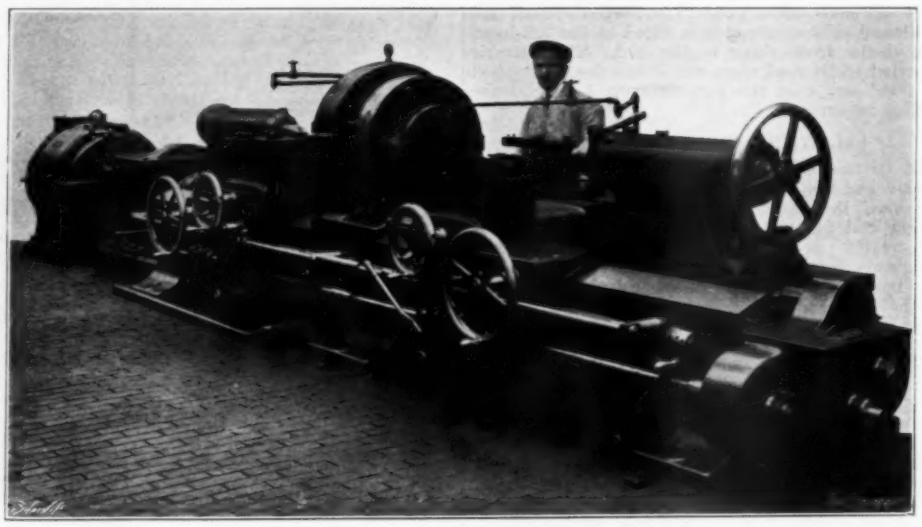


FIG. 78—RAILWAY AXLE TURNING LATHE—CRAVEN

shafts, and is illustrated as fitted up for the latter purpose. It is of the central drive type. The underlying principle is the grouping of the tools, so that the time for the whole of the operation is that required for the longest single cut. This method, with a combination of stops and feed trips, renders the machine extremely easy to operate, and very little skill is required to produce excellent results. With the addition of self-centring chucks or catch plates in place of the ordinary driving chuck, it can be

adapted to do many short jobs in one end of the machine.

The arrangement of the tool slides is shown in Fig. 79, from which it will be seen that the tools are rigidly held in detachable and interchangeable blocks that can be removed from the machine by unscrewing two nuts. This arrangement permits of a rapid change of tooling from one piece of work to another, the operation taking approximately 15 minutes. Taper

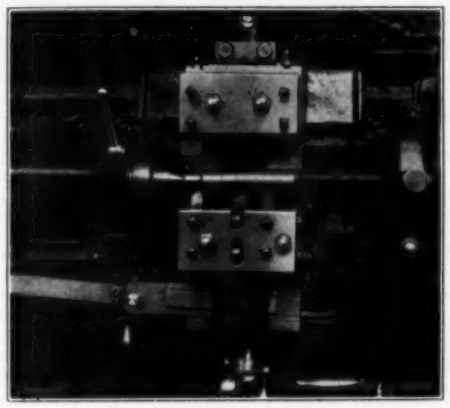


FIG. 79—TOOL SLIDES, MOTOR CAR AXLE LATHE

turning is effected by means of sliding tool holders operated by a tangent bar which is adjustable to accommodate the usual tapers.

There were also on this stand a number of A.W. circular tools and holders, which are made in three sizes, ¾in., 1¼in., 1¾in. diameter, for use on turret lathes, ordinary lathes, slotters, planers, boring mills, &c. They are capable of a very high duty and are economic, both in first cost and maintenance, as a very small quantity of high-speed steel is involved.

SNOW AND CO., LTD.

Grinding machines of the heavy type with segmental wheels were exhibited in several patterns by Snow and Co., Ltd., Stanley-street, Sheffield. One of the machines shown was the electrically driven rotary table vertical spindle surface grinder, which we illustrate in Fig. 80. This machine has a work table 32in. in diameter and a segmental wheel 20in. in diameter. The segmental grinding wheel is driven at 950 revolutions per minute by a totally enclosed motor mounted on the sliding grinding head and driving directly on to the grinding wheel spindle. The grinding head is overbalanced by weights and is raised and lowered relatively to the work by means of a small supplementary motor. The grinding wheel spindle is mounted in roller bearings and is fitted with an upward thrust device which is claimed to eliminate the possibility of end movement of the spindle. The grinding wheel is composed of ten abrasive segments surrounded by a steel retaining ring and held in position by gripping jaws and locking set screws. The work table is driven by means of a second supplementary motor through a P.I.V. variable-speed gear and a final spiral drive. By means of the P.I.V. gear the work table speed may be varied continuously over the range from 4 to 24 revolutions per minute. The control of the speed is obtained in a very simple and easy way by means of the small hand wheel to be seen on the extreme right of our engraving. On the box on which this hand wheel is mounted there is a small window through which whole numbers corresponding to the speed of the table become visible as the hand wheel is rotated. The work table is fitted with a magnetic surface. The table can be moved by hand away from or towards the grinding wheel to facilitate loading and unloading. A variable automatic feed can be applied to the grinding head and in addition a hand micrometer feed is fitted. All the three motors with which the machine is provided are started and stopped by means of remote control push buttons. The water supply to the work is obtained from a motor-driven pump drawing the fluid from a partitioned settling tank formed in the main bed of the machine. The fluid is delivered through an adjustable outside nozzle or to the inside of the grinding disc. The grinding disc and table are enclosed within guards, the doors of which are automatically opened when the table is brought forward into the loading position. The machine will admit a maximum height of 18in. between the magnetic face of the table and the surface of the grinding disc.

A second machine shown by Messrs. Snow was the reciprocating table vertical spindle surface grinder illustrated in Fig. 81. This machine is made with segmental grinding wheels, either 14in. or 20in. in diameter and with tables from 42in. to 110in. in length. It is driven by a single motor of 20 horse-power or upwards mounted on top of the grinding head column and transmitting power to the spindle through a flexible coupling and spiral bevel gearing. The reciprocating motion of the table is obtained from the same motor, the drive in this case being taken through reduction gearing and a change-speed box giving three changes of speed. A cushioning device is introduced into the table drive to enable the table to be operated at high speed without shock at the reversing point. The work table is formed with longitudinal tee slots, to which jigs or a magnetic chuck may be attached. The whole of the controlling mechanism is centralised on a detachable cover plate at the front of the bed. The controlling mechanism provided covers the automatic reversal of the table motion, hand reversing, a mechanical start and stop, an electrical push button control, a variable automatic feed to the grinding head, a micrometer index for hand feeding, and a hand traverse to the work table for use when setting up the work.

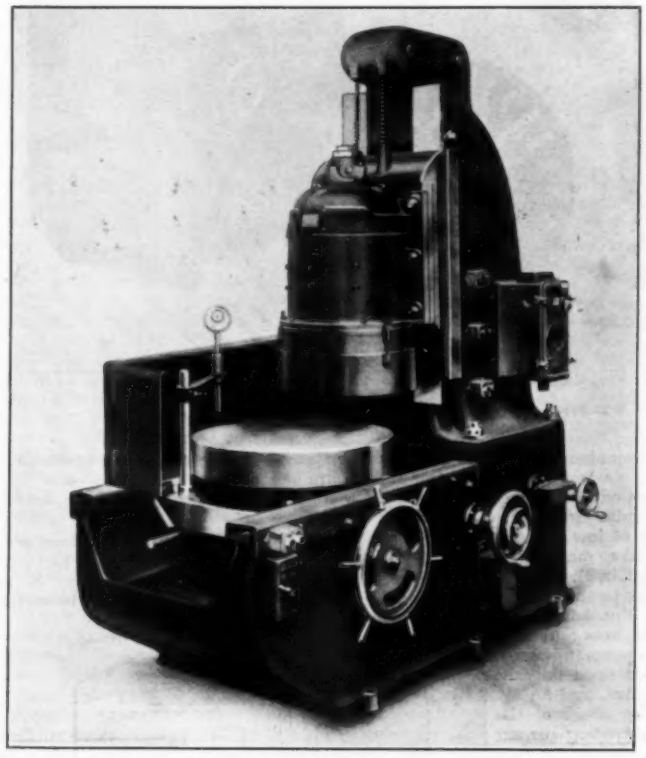


FIG. 80—ROTARY TABLE SURFACE GRINDER—SNOW

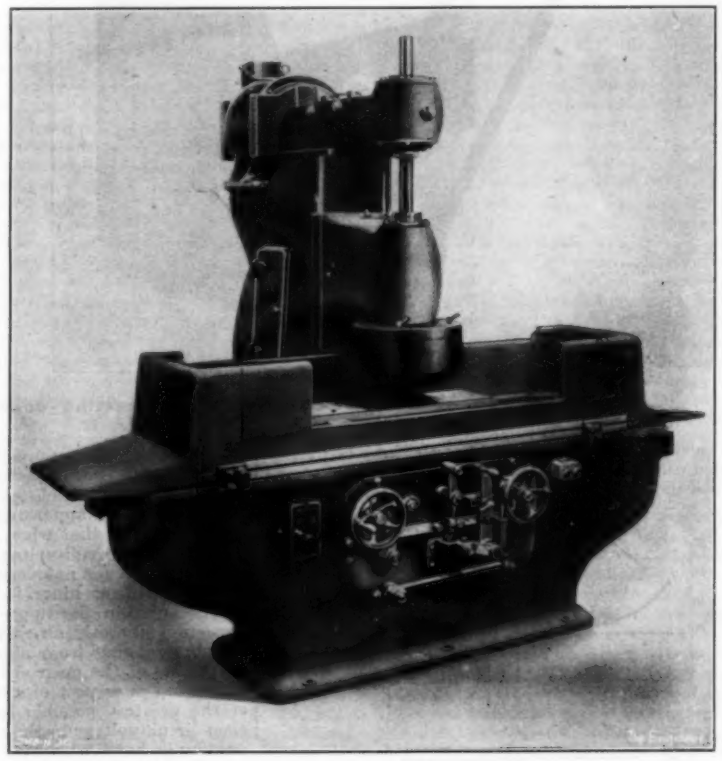


FIG. 81—RECIPROCATING TABLE SURFACE GRINDER—SNOW

THE CHURCHILL MACHINE TOOL CO., LTD.

One of the most noteworthy exhibits on the stand of the Churchill Machine Tool Company, Ltd., Broadheath, near Manchester, was the machine illustrated by Fig. 89, page 346, which is intended for the maintenance of the journals on railway axles by means of grinding. The machine is sufficiently large to accommodate a full-sized carriage or wagon axle with the wheels in place, and to work on both the journals at one time. The machine consists of a substantial base-plate, at each end of which are mounted respectively right and left-hand grinding wheel heads and dead centre headstocks. Each grinding wheel head is mounted on an independent bed fixed at each end of the main base-plate and is provided with an automatic reciprocating motion along its bed of 18in. through a four-speed change gear-box. Hand motion is also provided for convenience in positioning the grinding wheel in relation to the work. A transverse adjustment is provided for the purpose of putting on the cut. This transverse adjustment is fitted with a fine traverse together with a dead stop, for locating definitely the position of the wheel, and also with a quick withdraw motion. Two speeds are provided for the grinding wheels, which are 20in. diameter, 5in. wide. Provision is made for the truing of the wheels, also for the radiusing of the corners of the wheels to suit the fillet at the ends of the journal. Each grinding wheel head is independently operated and driven by its own motor, which is direct coupled, or belt drive can be arranged for if desired.

A special feature of the machine is the simple driving arrangement for driving the axle while both journals are being operated upon. This consists of a special design of belt having a profile conforming to the flange and tread, and driven by a driving wheel having a similar profile mounted on a swinging bracket at the rear of the machine. Convenient control is provided at the front of the machine for the necessary belt tension for driving whilst grinding and for quick release when removing work from the machine. This drive provides a powerful and smooth motion without vibration to the wheels and axle, enabling the journals to be quickly ground to the high finish necessary. The belt is not affected by water from the wet grinding operation. Provision is made for fitting this machine with a compound slide rest to each head in order that tools may be used for turning deeply scored journals, although generally the grinding wheels suffice.

THE BRITISH SECHERON COMPANY, LTD.

A welding machine of considerable interest was to be seen on the stand of the British Secheron Company, Ltd., of Abbey House, Victoria-street, London, S.W. 1. It differs from other machines in that it can be used for arc, spot or butt welding, and also for annealing and heating rivets, &c. The machine is illustrated in Figs. 82 and 83, the latter showing three sides of the case removed. When the machine is to be employed for arc welding cables connected to two terminals at the back of the machine are used. One of these cables is joined to the work and the other to the electrode holder. The desired amount of welding current is obtained by adjusting the hand wheel to be seen at the front of the machine. Spot welding is carried out in the ordinary way by placing the two pieces of metal to be welded together and by putting them between the two usual electrodes which grip the parts and cause a heavy low-tension current to flow. Butt welding is done by gripping the two parts to be welded, such as round rods in jaws, and by passing a heavy low-tension current through them until they attain a white welding heat. The hand

lever to be seen in the illustration is then pulled, thus pressing the two parts together and at the same time the pedal is released. The butt welding device can

FIG. 82—WELDING MACHINE—SECHERON

also be used for heating metal parts up to 14in. long for bending, forging, shortening, &c. Moreover, the butt-welding jaws are designed so that they can be used for heating rivets, one of the jaws being provided with a cavity for the reception of the rivet head, whilst the other is provided with a collar for supporting the body of the rivet. The machine may be used for heating soldering irons and for welding saw blades. The machine can, in fact, be employed for many purposes, including the heating of cold chisels prior to tempering, &c.

Another interesting exhibit on the stand was the a'ternating-current arc welding set shown in Figs. 84 and 85, which is claimed to give results equal to those obtained with the best continuous-current

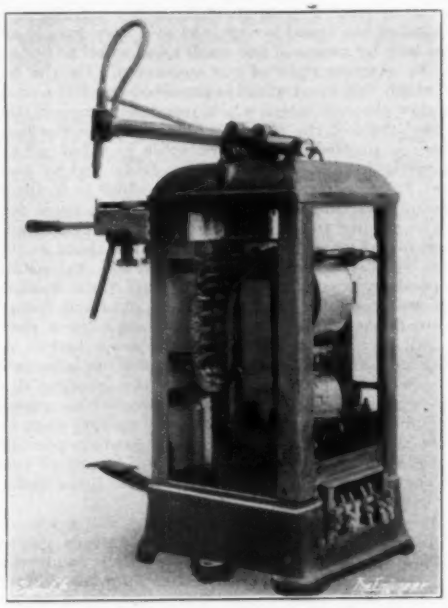
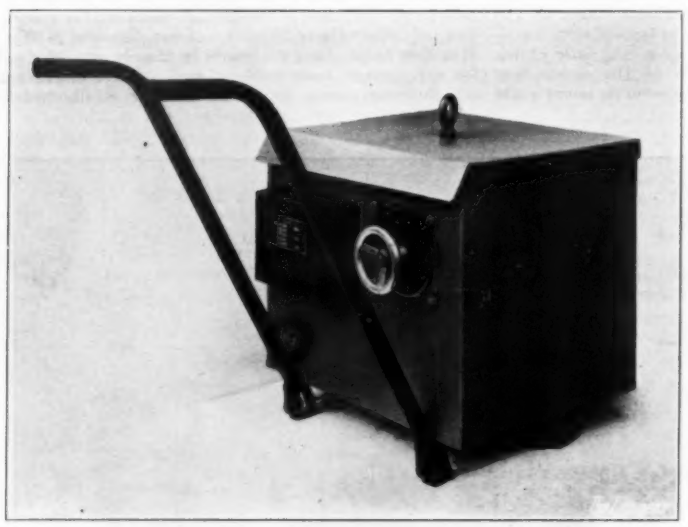
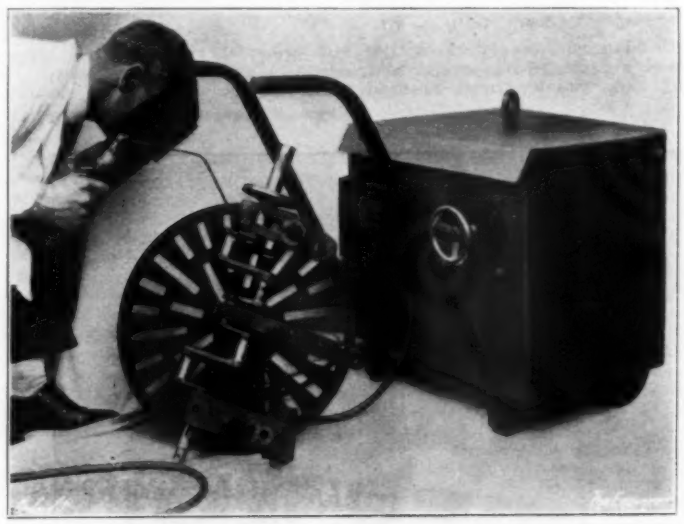


FIG 83—WELDING MACHINE, COVER REMOVED

sets, and to be very much more economical from the commercial point of view. The machine consists of a specially designed transformer, which naturally has a much higher efficiency than a motor generator.





FIGS. 84 AND 85—ALTERNATING-CURRENT ARC WELDING SET—SECHERON

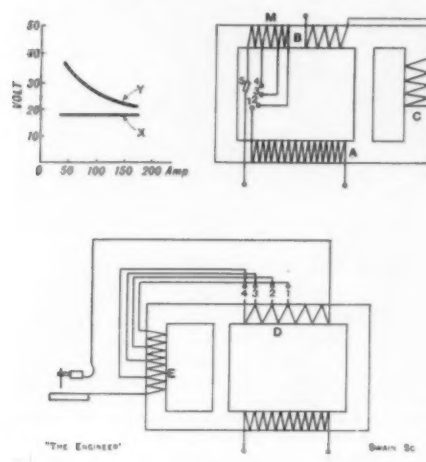


FIG. 86

The price is also very much less. The makers' explanation of the special feature of the machine is as follows. In the case of ordinary direct or alternating-current welding apparatus, the regulating devices are designed so that when a current of low value is used the open circuit voltage is reduced or maintained constant. This is not very important in the case of direct-current machines, for according to the characteristic curve in the upper part of Fig. 86, the arc tension X scarcely alters with short arcs and with currents ranging from about 60 ampères upwards. The value of the open circuit tension need only be considered in respect of striking the arc, and an arc of the greatest possible length. The effect of the open-circuit voltage in the case of alternating-current welding is, however, very different.

At a periodicity of 50 cycles the current is interrupted 100 times per second, and in introducing every half wave the voltage must first rise to a certain value corresponding to the striking value Y, in order that the current may be established again. The value of the striking voltage Y is dependent, to a very marked degree, upon the current strength, and increases very considerably with a small current, as shown by the curve. For this reason it is usual for alternating-current welding machines to have an open circuit tension of 70 to 90 volts, whereas for a current of 150 ampères, for instance, a pressure of 60 volts is ample. By fixing the welding current at 100 ampères the open circuit pressure must amount to approximately 75 volts in order to ensure a steady arc. When welding with currents of less than 100 ampères the no-load pressure must be still higher. The disadvantages of a high open circuit voltage are very pronounced, for the primary current in electric welding increases proportionately with the open circuit tension and reduces the efficiency.

In the machine under consideration, however, a single adjustment reduces the welding current and increases the open circuit voltage. By simply adjusting a switch, the highest current and simultaneously the lowest voltage can be obtained, whilst inversely the same switch will give rise to the lowest current and highest open circuit voltage. This is done by the arrangement of transformer windings—shown in Fig. 86—where provision is made for increasing the open circuit tension for small currents. In the case of the arrangement in the top right-hand corner of Fig. 86, part of the primary winding is on the limb A, and another part M on the limb B, on which the chief portion of the secondary winding is also placed. If only the part of the primary winding on the limb A is operative, then the induction of the magnetic circuit, and therefore the open circuit voltage is great. On the other hand, the leakage of the primary and secondary coils under these conditions is also great, so that the short circuit current is small. But if the part of the primary coil on the limb B is put into action the induction in the magnetic circuit is diminished, and the leakage is also diminished, to a predetermined value so that in the case of a short circuit of the secondary terminals or in welding, a stronger current is produced. Tappings for bringing about different desired results are shown at 1, 2, 3 and 4, and are made to govern the number of operative turns of the coil M by means of a switch. The part of the secondary coil on the limb C is separated from the part on the limb B in order to increase the leakage, and the limb C acts like a choking coil in decreasing the short circuit current. The open circuit voltage can also be increased or diminished when the welding current is altered in the manner shown in the lower part of Fig. 86, and we understand that this is the actual scheme adopted in practice. With the connection made at the point 1 the open circuit voltage is at its highest value, and the resulting welding current at its lowest value. A larger number of windings on the limb E are thrown in every time a few windings on the limb D are cut out.

Among the small tools which we noticed there was the chuck—see Fig. 87—by Clare-Collets, Ltd., of Thomas-street, Cheetham Hill, Manchester. It is very simple in design, but provides a very powerful

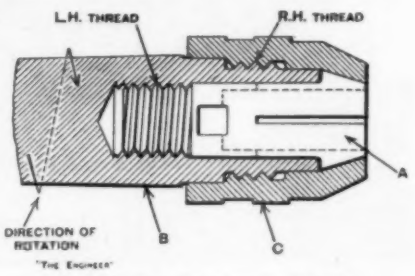


FIG. 87—COLLET CHUCK—CLARE

grip and will satisfactorily hold parallel shank drills or milling cutters. The chuck comprises three parts, a collet A, the body B, and the coupling C. It will be noticed that the threads with which the three parts are screwed together are of opposite hand, so that the driving effort tends to tighten the grip of the coupling on the conical end of the collet. For taper shank drills a tapered collet can, of course, be used. A fine display of nuts, bolts, screws, &c., was made by Alfred Beebee, of Wednesbury, and we had some interesting con-

versation on this stand, from which we learned that the whole of the output of the works is tested by Wickman gauges set to fine limits. The stand of Sternol, Ltd., Royal London House, Finsbury-square, was devoted to oils, lubricants, and so forth, and a small high-speed milling machine was utilised to demonstrate the non-frothing character of the maker's cutting lubricant. The transformer oils, also, seemed to be remarkably free from sludge.

World Fuel Conference.

No. I.

INAUGURAL PROCEEDINGS.

THE inaugural meeting of the World Fuel Conference, organised by the British National Committee of the World Power Conference, and attended by representatives of forty-eight countries, was held at the Imperial Institute, South Kensington, London, on Monday, September 24th.

Lord Reading, the President of the Conference, was in the chair and extended a most cordial welcome to the delegates, among whom there were forty-eight nations represented. The British Government's appreciation of the character of the Conference was proved by the interest taken in it by the President of the Board of Trade, and by the fact that there was to be a Government reception of the delegates.

Sir Robert Horne, in his inaugural address, said that no assembly of scientists had ever come together to discuss a matter more relevant to our common everyday life, nor had any technical conference ever been held from which so many practical consequences, vital to the prosperity of the countries represented, might flow. He commented upon the universality of the interest evinced in the purpose of the Conference, which was demonstrated by the fact that twenty of the forty-eight countries represented had submitted papers of serious import discussing particular aspects of the question from the point of view of their experience. There were many countries like Great Britain in which fuel must always be the main source of power, and whilst fuel of all kinds was within the ambit of the discussions, two-thirds of the 170 papers submitted dealt with coal. As showing how vital was this subject to the citizens of the country, he said that one-twelfth of all our population depended on the coal industry for their livelihood, and four-fifths of the volume of our exports and one-tenth of their value normally consisted of coal. He personally had never taken the view that the day of prosperity in the British coal industry had passed for ever, and that the competition of oil would make it unprofitable to work coal here to anything like the same extent as in the past. The modern prosperity of Great Britain was created by coal, and by coal it would be saved; but it would only be by adopting improved and more economical methods of using it. The pouring of raw coal in a crude state into furnaces and domestic grates must now be recognised as a tragedy from which we must find a way of escape.

Sir Robert expressed himself optimistically with regard to low-temperature carbonisation processes, and said he looked with most hope in this country to the development of some of those processes. Something like 400 processes had been tried. The difficulty had been to produce a semi-coke which could easily be consumed, both industrially and domestically, and whose value, along with that of the by-products, would be sufficient to cover the cost of the process and the original raw material. He believed we were at last emerging from the experimental stage and entering upon the industrial and commercial period of development in connection with some of these processes. The enterprise of one of our electric supply companies had shown what could be done with British coal. By carbonising a comparatively low-grade coal at a low temperature and burning the residual fuel under the boilers that company had been able in effect to pay for the bulk of its raw material with the value obtained for the by-products, and had succeeded in producing electricity at a price as low as any in the world. Referring to the hydrogenation of coal, by which six times as much liquid fuel was obtainable as under the method of low-temperature carbonisation, though there was no residual coke, he said the application of the process had been so successful in Germany that very large sums had been invested in plant and equipment by a very strong organisation. Our bituminous coal was more difficult to deal with than the German lignites, and one could not say that the oil so produced could compete in the market at the price at which oil from wells could still be sold, but it was quite possible that in a country with a tariff against imported oils the native product could be sold against the imported product, and such a country could be independent if supplies from outside were cut off. Sir Robert drew attention to the steady development of pulverised fuel. Other economies in the use of coal were in the way of being achieved. Waste heat from coke ovens, blast-furnaces, and steel furnaces was being turned to industrial use, and great advances had been made in this direction in Germany and France. Methods of producing synthetic liquid fuels were engaging close attention, and suggestions were being made for the establishment of centres from which gas might be distributed over wider areas than had even been thought of before.

Speeches by representatives of the participating countries were made by Dr. E. C. Köttgen, of Germany, on behalf of European countries; Mr. O. C. Merrill, the Executive Secretary, Federal Power Commission, U.S.A., on behalf of the U.S.A. and the South American States; Mr. B. F. Haanel, Chief Engineer, Division of Fuels and Fuel Testing, Department of Mines, Canada, on behalf of the Dominions; and Dr. M. Kamo, Professor of Mechanical Engineering, Tokyo Imperial University, on behalf of the Asiatic countries. Dr. Kamo referred to the World Engineering Conference, a sectional meeting of the World Power Conference, to be held in Tokyo in October and November, 1929, and he extended a hearty welcome to all nations to send their delegates.

BANQUET.

A banquet was held at the Connaught Rooms, Kingsway, London, on Monday evening, the Marquis of Reading presiding over a large company. After the toasts of "His Majesty the King" and "The Sovereigns of the Kingdoms and the Presidents of the Republics Represented" had duly been honoured, Sir Philip Cunliffe Lister (President of the Board of Trade) proposed "The Fuel Conference," and in commenting on the fact that forty-eight nations were represented at this sectional conference, as against forty at the full conference at Wembley in 1924, said the nations of the world were appreciating the importance of pooling knowledge, not only within industries, but as between one industry and another and between one country and another Absurd undercutting of prices on the part of coalowners was bad, not only for the coal industry, but, in the long run, would be bad for the industries depending upon coal. Such competition should be eliminated by efficient organisation in the coal industries themselves. With regard to extending the field of pulverised coal to marine work, he was glad to say that there was already co-operation between the shipowners, shipbuilders, engineers, and coalowners in a great experiment, which he felt justified in saying had already achieved some measure of fruition. Combination in the coal industry again meant efficient plants for coking and by-products, and this at once brought into the field the gas industry, the chemical industry, and iron and steel. Incidentally, it was a very fortunate circumstance that the report of the National Fuel and Power Committee, which he appointed eighteen months ago, should have been made at a time when this Conference was being held, and in that report was one very valuable suggestion upon which he proposed to take immediate action. The suggestion of the Committee was with regard to an inquiry into the use of surplus coke oven gas and the proposal was that an investigation should be made in some area such as that between the Mersey and the Humber, to see whether gas undertakings there could not take a supply of gas from coke oven plants already existing or which might be developed there in the future. That was an inquiry well worth undertaking. It would be ascertained what was the consumption in the area, what gas was obtainable, what was the actual demand to-day, and the prospective demand and supply in the future, and also what effect such a development would have on the coke industry itself and upon the market for coal. The National Fuel and Power Committee suggested that such an inquiry could only be undertaken by the Government, and he, speaking on behalf of the Government, was able to make the announcement that the Government proposed at once to do so. At the same time, he was sure he could rely upon the assistance and co-operation of all concerned in such an inquiry and he had one request to make. Work of this nature required an efficient and experienced staff, and his proposal was that this staff should be supplied from the existing staffs of the industries concerned, because they would have the necessary experience for the task. This was a great national inquiry, and he felt sure that when he asked for this help and co-operation it would readily be forthcoming. Finally, Sir Philip Cunliffe-Lister referred to the great scope for the work of fuel technologists and the need for greater assistance to the universities on the part of the industries concerned, so that men might be suitably trained for taking their place later in the industries of the country.

The Marquis of Reading, who responded to the toast as President of the Conference, first expressed the thanks of the Conference to Sir Philip Cunliffe Lister for the cordial welcome he had given to the Conference. In spite of this, however, he was convinced that the work of the Conference would result in lasting benefit to the nations of the world. The Conference was not national, but international, and one of the striking features of it was that notwithstanding various and even competing interests were involved, the spirit which imbued the whole Conference was to find out, regardless of the particular interests of one industry or another, the means to develop along the lines of knowledge, and to add to the stock of knowledge of the world, whereby cheaper and better means of production might be ensured. There was, however, another aspect of this question which impressed him, and if he spoke with a little more enthusiasm than was permissible among scientists and technicans, he hoped he would be pardoned when it was realised that he was speaking from a deep conviction. The impression which remained with him was that these forty-eight nations representing the Conference—some of which were only recently at war—were meeting without regard to political differences, and were engaged upon a common object with a common interest, not of adding to the particular nation's asset, but of contributing something to the interest of the whole world. It was a great ideal, this seeking to develop the prosperity of the world, because that linked everybody together and made us all co-workers with the same object, and made us all co-operators in the cause of a great world peace. This work should make it clear that science should no longer be employed in the work of destruction, and he felt convinced that by such conferences as these, we were laying foundations which would help materially towards achieving world peace.

The toast of "The Guests" was proposed by Sir David Milne Watson, and was acknowledged by Monsieur Guilleaume (France), Dr. E. Tissot (Switzerland), and Mr. F. V. Hansen (Sweden). The final toast of "The Chairman" was proposed by Colonel R. K. Morcom, and was briefly acknowledged by Lord Reading, who mentioned the privilege he felt it to be to take the place of Lord Melchett, now out of the country.

COAL INDUSTRY: ECONOMIC AND GENERAL CONSIDERATIONS.

The real work of the Congress commenced on Tuesday morning. Section A met in the large hall, under the chairmanship of Lord Aberconway, to discuss fourteen papers grouped together under the title of "The Coal Industry—Economic and General Consideration"; while Section E met in the smaller hall, with Sir Robert Waley Cohen as chairman, to discuss two papers under an exactly similar heading, except that the word Oil was substituted for Coal. It was to have been expected, in view particularly of the word "Economic," that among the first group of papers, some at least might have been devoted to the economic plight in which the coal industry finds itself in so many countries. This anticipation, however, was not realised. The financial problems of the coal industry were entirely ignored, most of the papers being descriptive of the coal resources of different countries, and the methods of using the low-grade lignites and the coals of the post-carboniferous Age in various parts of the world. Several authors drew attention to the urgent need for a universal system of coal classification, and a standardisation both of methods of testing and of expression of results. Under the title of "*The Classification of Coal*," Mr. A. C. Feldner described the way in which the American Engineering Standards Committee were dealing with the subject. This Committee, in conjunction with the American Society for Testing Materials, had appointed three technical committees to review the whole question. One Committee concerned itself with a scientific classification of coal, based on chemical and physical properties, and with reference to origin and constitution. The second committee studied the classification of coal according to its uses, while the third was to collect information on commercial practice for the benefit of the other two. The scientific committee consisted chiefly of chemists, geologists and paleobotanists, but "there is also included a minority of practical fuel engineers to keep the scientific men from wandering into the field of impracticability." After each of the two technical committees has issued its report, the entire committee will endeavour to harmonise the requirements of custom with those of science, in the hope that a simple and satisfactory system of classification may be ensured. It was suggested by Mr. Feldner that other coal-producing countries might organise similar committees, who would eventually co-operate in agreeing on a uniform system of classification for all countries.

Many of the remaining papers served as a useful reminder to engineers of the large proportion of the coal in the world which was of the lignite or brown coal type. These coals, practically unknown in England, were said to constitute 98 per cent. of the Canadian coal reserves, and 68 per cent. of the reserves of the United States. Indeed, of the total coal resources of the world 50 per cent. were said to consist of the post-carboniferous coals of North America. At present only 5 or 6 per cent. of the U.S. production is of this Age, though of Canadian output 60 per cent. is post-carboniferous. The Australian lignites were well known, and the magnitude of some of the deposits was shown by the fact that near Morwell a borehole 1019ft. deep passed through no less than 780ft. of coal, and even then was not out of the coal measures. Extensive deposits occurred in Germany, and smaller ones in Czechoslovakia, Russia, Korea and the Dutch East Indies. The lignitic coals were non-coking and were characterised by high moisture contents. These properties necessitated special methods of utilisation, which were considered in several papers. In "*The Combustion of Brown Coal in the Australian Commonwealth*," by the Chief Engineer of the State Electricity Commission of Victoria, the work done in Australia in the development of burning brown coals of high-water content was fully described, and test results were given. The Yallourn brown coal with 64 per cent. of moisture gave, as might be expected, much more trouble than the Morwell coal with its 50 per cent. of water content. Mechanical step-grates used in conjunction with pre-drying shafts had proved

successful and preheating the air for combustion was advantageous. Heated air was also found useful for burning some of the Russian lignites.

Professor Kamo, in a paper on "*Korean Coals and their Utilisation*," described the Asorbus carbonising plant designed for low temperature treatment of brown coals, and gave tables of yields and the properties of the products. The coal was agitated in the retort by means of paddles, and carbonised at a temperature of 500 deg. Cent., the volatiles passing backwards through the incoming coal. The carbonised residue was used for pulverised fuel firing. The results so far obtained indicated that the low temperature carbonisation of brown coal, combined with pulverised fuel firing, carried out at the mine were efficient ways of using the lignite in question. The carbonisation of lignites at high temperature was described in a paper entitled "*Methods Used for the Improvement of Lignites in Czechoslovakia*," by J Formanék. Carbonisation was carried out in a modified form of Appolt oven. Plants capable of dealing with more than 300 tons per day each had been in use for a number of years. The temperatures employed were from 1100 deg. Cent. to 1300 deg Cent. The carbonised residue was screened to three sizes; the fines were briquetted with lignite tar pitch, and the larger sizes used for firing boilers and gas producers. About 40,000 tons of Bohemian lignite were gasified annually in producers of the Mond, Kerpely, Koller, Heller, and other types. At the Mannesmann works a low-grade lignite containing 30·5 per cent. moisture, and 31·82 per cent. of ash in the dry coal, with a calorific value of 5400 B.Th.U.'s per pound was gasified in a Mond producer. From one metric ton of raw lignite were recovered 45,000 cubic feet of gas at N.T.P. of 158 B.Th.U.'s per cubic foot, 61·4 kilos. of tar, and 16·5 kilos. of ammonium sulphate. About 200,000 tons of lignite briquettes were made annually in Czechoslovakia, no binders being employed, but pressures up to 120 tons per square inch being used in the moulding machines.

Lord Aberconway, in opening the meeting, said that in England there was no organisation in the coal industry. When we looked at Germany, however, we found the coal trade was in a position of comparative security, with regulation of output at prices, and with associations able to deal with the mineowners and coal producers in other countries. There was nothing of that sort in England, which, the oldest coal-producing country in the world, had to-day an output far in excess of its own requirements, and therefore had to depend largely on exporting coal. Our system however, was bad. The coal was owned by landowners who compelled the collieries to work the coal, whether at a profit or loss. The classification of coal was of the utmost importance, and even if the Conference did nothing more than establish a system of classification, it would be doing excellent work.

Mr. J. Roberts then presented the General Report on the subject of the meeting.

Mr. W. Thorneycroft (vice-chairman) referred to the widespread attempt to devise a simple system of classification, and said that whether scientific classification could be used in commercial practice had still to be determined. Before the war the commercial value of all coals was adjusted by the free play of competition between producers. Each consumer was supplied with the available variety best suited to his purpose as the result of accumulated practical experience of producers, distributors and consumers. The classification for commercial purposes, therefore, was automatic and extremely delicate, but dependent upon competition. It would not be disputed that the producer who could succeed in delivering a suitable variety of coal to any consumer at the lowest price would command the market, and it was difficult to see how any specification or classification of that variety would alter this fact, although subsidies to lower the cost of production or distribution certainly would. The subject of such subsidies was not the object of the Conference, but these and other essentially commercial matters must be considered before deciding whether any commercial classification based upon scientific classification would be desirable, possible, and equitable. In all the intensive scientific study of the characteristics of various coals, the samples worked upon were presumably drawn from particular seams, but when we came to commercial classification it must be remembered that we have to deal frequently with mixtures or blends of various seams, and the vexed question of sampling as well as the method of analysis must be considered. The resources of what were called low-rank coals were dealt with in several papers, and it was evident that these had been brought into prominence by political considerations which were outside the present discussion. Their use and treatment, however, depended upon, and varied with, the amount of water and ash in them. As to the treatment of these coals by high and low-temperature carbonisation, he thought it would be found that each particular coal required a special study, and that it is not safe to say that any particular form of apparatus successful with one coal would necessarily be satisfactory with another.

Mr. E. G. Sahlin (Consul-General, Sweden) said that Sweden had gone into the question of classification to such an extent that some of the larger consumers of coal there bought under guarantee in regard to heat value, ash content, and moisture. Present methods of classification throughout the world, however, were far from satisfactory, and such an expression as "large steam coal" formed a quite insufficient basis for judging the properties or value of that coal. As a matter of fact, it had often been found that so-called large steam coal contained up to 30 per cent. or 40 per cent. of small coal, which necessarily affected the quality. Moreover, on account of lack of internationally agreed terms, difficulties often arose after delivery, and it was with the object of arriving at some system of internationally agreed definitions of the properties of coal that the Swedish delegation desired to put before the Conference the following resolution:—

> "Whereas it appears desirable that an international nomenclature for the classification of coal with regard to its properties be adopted, and that a uniform system for the determination of the fundamental properties of coal be established: Resolved, that the International Executive Committee of the World Power Conference be requested to take suitable steps to that end."

The Chairman said this resolution had been accepted by the Executive, and was open to discussion.

Mr. C. E. Le Maistre (Secretary, B.E.S.A.) said this was a matter not only of scientific, but of great commercial importance, and therefore the greatest caution should be exercised in passing such a resolution, because for the World Power Conference to set up any organisation to attempt international standardisation at the present time, would not only not be progressive, but would be harmful. There were other organisations already in existence to do this work, and he felt the policy to adopt was for every country to put its own house in order before any attempt whatever was made towards international agreement.

Dr. E. W. Smith (Technical Secretary to the Conference) explained that there was not the slightest intention of setting up any such organisation; the whole object was to empower the Executive to take steps to get the work done. There was no organisation at present in existence to do that, and the sole object was to co-ordinate the work of the existing organisations, such as the B.E.S.A. and other international bodies.

Dr. A. Parker (Leeds) said it was obvious that differences would be necessary in different countries, owing to the different circumstances existing. At the same time there were certain methods which might well be standardised, and some scheme for arranging co-operation between the different countries would have to be devised.

The resolution was then put to the meeting, and carried.

Mr. H. Laffer Lewis (Victoria) gave some account of the use that is being made in Victoria of the abundant supplies of brown coal there. Victoria, he said, has more brown coal than even Germany, which was admittedly the home of the brown coal industry. Some of the seams were 400ft. to 500ft. in thickness, and in one case a thickness of 800ft. had been found in a bore of about 1000ft. This brown coal was very similar to German brown coals, and was being used satisfactorily for the generation of electricity by the State Commission. When the Commission in 1921 first opened its power station at Yallourn, twelve boiler units were installed, each capable of evaporating 70,000 lb. per hour at a pressure of 260 lb., and a temperature of 650 deg. Fah., working in conjunction with six 12,500-kW machines. That plant, however, was being extended at the present time, and a further ten similar boiler units were being installed. When the State Commission first started there was not that co-operation with Germany which now existed, and great progress had since been made in dealing with the high moisture content in this brown coal. In the last boiler units which had been installed, a type of mechanical step grate had been adopted with great success, together with preheated air, and he believed it would be admitted that preheating of the air in the burning of low-grade wet lignites or brown coals was very necessary. The briquette factory at Yallourn, which had been established by the Victoria State Commission, at present was turning out 400 tons of briquettes per day, but that was being increased to 1250 tons per day, and at the same time the steam pressure was being increased to 650 lb. and the temperature to 750 deg. Fah., resulting in considerable reductions in fuel costs. Similarly, work upon pulverising brown coal was meeting with success, although at present the cost was rather high, due to the high price of labour and materials in Australia. A report on the whole matter had been prepared by the Commission, and was now available.

Mr. William Erdos (Budapest) discussed the combustion of brown coal and lignites and the three kinds of mechanical stokers commonly in use for this purpose. The problem, however, he said, was to construct a stoker able to burn economically and with a high capacity both high-grade and low-grade coals, and he claimed that such a stoker had now been produced in Hungary.

Professor L. K. Ramzen (Moscow) said that the results achieved by the State Commission of Victoria on the combustion of Victorian brown coal corresponded in the main with the results obtained by Russian engineers, although the work had been carried out independently. He believed, however, that as the Australian brown coal had a low ash content and a high content of volatile matter and moisture it would be necessary to abandon the idea of burning this coal in a pulverised form until the method of pulverising such coals without preliminary drying was improved. The application of a pulverised fuel system to brown coal combustion as compared with mechanical stokers could only give a negligible increase of boiler efficiency, which, however, would be eliminated owing to the higher combustion of fuel and losses during the drying process. The Victoria State Commission had worked out a correct and economical method for burning brown coal and had solved a very difficult and technical problem. It appeared to him that good results should be achieved by providing the chain grates with hot blast and pre-drier of a shaft type. The pre-drying could be intensified by sucking hot flue gases through the fuel bed in the upper part of the shaft, *i.e.*, leading the gases through in a direction opposite to that of the air. Such a method had been successfully applied in the burning of tan bark, containing a high percentage of moisture. Finally, it was stated that in the opinion of the Russian delegate the time had come to stress the necessity for forming a special international committee, and they asked the World Power Conference to take the initiative in connection with preparing international standard specifications relating to all branches of power engineering.

Dr. Tomaides (Vienna), on behalf of the Austrian delegation, expressed the view that tests of particular coals in different countries should only be decided upon after an international standard had been agreed.

Sir Albert Kitson (Gold Coast) said that Nigeria contained brown coals comparable in quality and thicker in depth than were to be found in any other part of the world. There was, he said, a distinction to be drawn between the lignites of Germany and the brown coals of Australia and Nigeria, because the brown coal was homogeneous, whereas the lignites contained fragments of logs or trees, and this fact had an important bearing on the problem of combustion.

Professor M. Kamo, Director, Fuel Research Institute, Korea, expressed a doubt as to whether anthracite can be burned successfully if it contained 5 or 6 per cent. of moisture, but in the Fuel Research Laboratory in Korea he had been successful in burning such anthracite coal by pulverising it. Since writing the paper it had been found possible in Korea by low-temperature carbonisation to produce a semi-coke amounting to 55 or 60 per cent. of the raw coal and having a calorific value of 25 per cent. higher than the raw coal on the average. Moreover, the evaporative capacity of this semi-coke was 40 to 50 per cent. higher than pulverised raw coal, and, taking all the factors into consideration, he came to the conclusion that this semi-coke, the product of low-temperature carbonisation, when pulverised, was the equivalent to about 80 per cent. of the raw coal. This plant could be installed for from £400 to £450 per ton of coal carbonised per day per capacity and as low-temperature tar fetched £2 10s. per ton, it was evident that the best way of using the Korean brown coal was to carbonise it first and pulverise the semi-coke and utilise it for the generation of power.

Mr. H. Van Hetting Tromp (Holland), referring to the classification of coals, said that the term bituminous coal covered a great many grades and quality, and therefore some clearer and more definite classification was necessary. At the same time, the classification outlined in the general report was not so rational as he would like, and it would be much better not to speak in general terms of bituminous coal. He had gone into this matter when he was general manager of the Sumatra coal mines and had been able to classify the coals under various headings, and something of that sort was required in all the countries of the world. Similarly, the use of the word "ulmin" in a general way was to be regretted, because the expression covered more than one constituent of coal. A method of dealing with coal which appealed to him most was one by which liquid fuel and gas would be extracted in such a manner that there would be practically no solid fuel left at all.

Oil Industry: Economic and General Considerations.

Simultaneously with the discussion on the Coal Industry, a corresponding discussion on the Oil Industry took place in the smaller hall, where Section E of the Conference met under the chairmanship of Sir Robert Waley Cohen. Two papers only were presented to the meeting, one on "*The Economics of the Oil Industry*," by Mr. E. H. Davenport, and the other on "*The Oil Industry of Japan*," by Mr. K. Hashimoto. The former paper dealt with the fluctuations in the gasoline market and their causes. Since the war the greatest problem before the industry had been to keep pace with the demands of the motor car users. The demand for gasoline for the domestic and export markets of the United States of America in 1927 was about nine times that of 1914, while in Japan the demand had been trebled during the last six years. Had not methods of increasing the proportion of gasoline from crude oil been devised, the present consumption of gasoline would have necessitated the production of more than double the present output of crude oil. Matters had also been helped by the extraction of gasoline from natural gas. The gasoline derived from natural gas had increased

by 1473 per cent. since 1916, and that produced by cracking processes by 1359 per cent. The costs of well drilling in the United States of America had increased year by year, due largely to the need for going to greater depths. In 1913 the average cost of drilling a well was 4765 dollars, while in 1927 it was no less than 18,725 dollars. The price of gasoline bore no systematic relation to the cost of manufacture, but was regulated by the supply and demand of the various products of distillation. An average barrel of oil yielded 27 per cent. of gasoline, 10 per cent. of kerosene, 46 per cent. of fuel and gas oils, and 7 per cent. of other products. If the cost of manufacture of these substances were taken as proportional respectively to the quantities obtained, it would be found that some must be selling at a loss. Gasoline had to carry a price which would return a greater proportion of the total receipts than its proportion of the total quantity of products would seem to warrant. It was necessary to charge a relatively higher price for gasoline in order to secure the production of the quantity demanded at the expense of other products.

The report on the two papers referred to above was presented by Mr. J. Kewley, who took part in the discussion and gave some supplementary information and figures. He mentioned that a calculation which had been made showed that the total volume of crude oil already extracted from the earth only amounted to 0·8 of a cubic mile, or about enough to fill Loch Lomond. The processes of cracking had been greatly developed, and he could not agree with Professor Defay's statement that cracking was a transitory process and its gasoline product poor in quality. New products from the residuals which were now being employed in the asphalt and road surfacing industries would tend to reduce fuel prices, as would also the use of natural gas supplies.

Dr. G. Egloff referred to the previous speaker's estimate of eight-tenths of a cubic mile for the crude oil already extracted from the earth. He said that in the United States alone there was to-day an area of 1100 million acres of possible oil-producing land, of which only two million acres were now being worked. The output from the West Texas fields had outdistanced that of the Seminole area. In Texas there were ten wells, which at 1100ft. depth had a potential output of 3½ million barrels of crude oil per day, or more than the world's demand. There was an excess for many years to come. New uses of fuel in America which tended to keep the price of petrol low were gas oil for household purposes and the production of asphaltic phenols from residuals by oxidation. A rubber-like substance might be produced as a by-product from the cracking of oil, which could be made in large quantities.

Sir Robert Waley Cohen said that he did not recognise such terms as good and better petrol. The experts had further to go. Mention was made that high boiling fractions had been eliminated from petrols, but was, he asked, that altogether an advantage. If we knew how to utilise them then these fractions might be most valuable in the fuel. He looked forward to a healthy rivalry between the user of the petrol engine and the user of the high-speed heavy oil engine, both of whom would make demands upon the oil producer for good fuels. There was no doubt that if the Diesel engine were to succeed for motor vehicles then the heavier fuel would be called upon to bear a larger share of the production cost. The cost of the lighter fractions was almost the same as the heavier fractions, and price differences were fortuitous. The real value of a fuel was its capacity to produce power.

Mr. W. A. Whatmough spoke as one interested in the petrol engine and the production of good petrol. He thought that if some definite standard for No. 1 petrol could be fixed it would be advantageous. The leading suppliers, he thought, produced petrols with very consistent qualities, but various distillates offered were by no means so consistent. The anti-knock qualities had been generally greatly exaggerated, and sometimes bad engine design had been overlooked.

INTERNAL COMBUSTION ENGINES.

The nine papers presented in this section, which embraced contributions representing the views of British, Belgian, German, Swiss, Swedish, and Russian authors and groups, may conveniently be considered in three categories. First, those which dealt with volatile fuels for motor engines; secondly, those which dealt with heavy fuels; and thirdly, the papers in which problems of engine design and operation were discussed.

In a paper presented by E. Rackwitz and A. von Philippovich (German Air Research Institute), entitled "*Evaluation of Fuels used for Aviation in Germany*," some of the tests used for petrol fuels were described. German aviation fuel was principally made from mineral oils, but fuel made from lignite had also been employed, and petrol-benzole mixtures used. The compression ratio of German aircraft engines lay between 1 : 5·5 and 1 : 6·3, and the latter figure was one which made the task of finding a suitable petrol fuel a difficult one. The main features of each test were described, and its method given. An interesting test was that employed for corrosive properties. A piece of copper foil, in which aluminium or magnesium rivets had been inserted, was introduced into the fuel. If the fuel possesses corrosive properties then the presence of aluminium or magnesium hydroxides became apparent at the junction of the metals in about twenty-four hours. Sulphur compounds were detected by the discoloration of the copper. The sulphur content was limited to 0·3 per cent. Professor E. Hubendick (Swedish National Committee), described in his paper entitled "*The Use of Ethyl Alcohol as a Motor Fuel*," the efforts which have been made in Sweden, in the direction of using an ethyl-alcohol as a motor fuel. In the production of sulphite pulp, a sugar was obtained —roughly, 2 per cent. of the timber weight—which could be easily converted into alcohol by fermentation and distillation. Such alcohol could readily be mixed with motor fuel, and in order to denature it the use of about 0·19 per cent. of croton aldehyde had been proposed. Tests made with various mixtures were given, and showed that whereas additions of 23 per cent. of alcohol to a motor fuel did not require any alterations to be made to the carburetter arrangements, with additions of over this amount the intake air must be heated to compensate for the high latent heat of the alcohol, and its specific gravity taken into account. The question of the sensitiveness of the alcohol-petrol mixture to water was discussed, this subject being also dealt with in the paper on "*Power Alcohol*," read in Section S.

Under the title of "*Petrol Engines and their Fuels*," Messrs. H. R. Ricardo and O. Thornycroft (Institution of Petroleum Technologists) discussed factors influencing engine efficiency, engine, power and compression ratio, and also dealt with the usefulness of anti-knock dopes and the volatility of engine fuels. The thermal efficiency, and therefore the power of an internal combustion engine, depended largely on the compression ratio, a well-designed engine working on any volatile liquid being able to realise about 72 per cent. of the air standard efficiency corresponding to its compression ratio. The most important factor in design which influenced detonation was the absolute distance from the point of ignition to the remotest corner of the combustion chamber. Given similarity of design, therefore, the smaller the cylinder the higher the compression ratio with any given fuel. The relative tendency to detonation as between different fuels was nearly the same for different engines. The greater the molecular weight of a fuel of the paraffin series, the greater in general the tendency to detonation. The effectiveness of lead-tetra-ethyl as an anti-knock, was shown by the fact that one molecule of this substance in 50,000 molecules of the fuel and air mixture might raise the highest useful compression ratio by one ratio, and the efficiency thereby increased by 10 per cent. Owing to the adverse effects of the deposits formed in the engine, only very small concentrations of lead ethyl could be employed. In road vehicle engines it had been found that up to 3·5 c.c. of ethyl fluid per gallon of petrol could be employed without harm. With this proportion, the highest useful compression ratio with a good petrol could be increased by 0·6, and if the engine compression were raised by this amount, the efficiency would be increased by 5 per cent. For road vehicles, owing to the limitations set by residue, the advantages either in power or economy to be gained by anti-knocks were small; at least equal scope for improvement was to be found in engine design. For engines where a high duty was required for a short time, anti-knocks were of high importance. The more volatile the fuel, the greater the heat value per pound, but the less per gallon. Taking as the measure of volatility the temperature at which 70 per cent. of the fuel is condensed, it was found that first-grade motor spirits had a volatility of 134 deg. Cent., third-grade spirits of 138 deg. Cent., while a large transport company found it economical to use a fuel with a volatility temperature of 160 deg. Cent., by careful design of the engine and by maintaining a high temperature in the induction system. With a suitably designed engine a highly volatile fuel gave no greater power than a low volatile fuel.

In a paper on "*Heavy Fuel for Oil Engines*" (Diesel Engine Users' Association), Mr. Harold Moore dealt with the various available oil fuels which are suited to heavy oil engine work, and the question of laboratory analysis. In a brief history of the fuel question the author lead up to the present position. To-day the majority of Diesel engines were using residual oil obtained by the topping of crude petroleum or blended oils made by mixing such residues with gas oil of petroleum origin. The gas oils generally had a range of specific gravity from 0·835 to 0·865, while residual oils varied from 0·870 to 0·980, the oils over 0·930 being rarely used. As at the present time, the petroleum industry was suffering from over-production, there was no incentive, as in the past, to use the heavier residues. A new product was the residual oil obtained from cracking plants. The author put forward eight laboratory tests which included the determination of the specific gravity, closed flash-point, cold test, heat test, ash content, water content, coke value, and the estimation of the hard asphalt content. These might be used for the gauging of oils. In the concluding paragraph some points of engine design were touched upon. It was remarked that high compression assisted in burning heavy oils, and that moderate mean effective pressure ratings were also to be recommended. In the author's opinion, airless injection engines were now able to give similar results to those obtained with air injection motors, probably owing to the absence of the cooling effect of the blast.

The paper presented by Professor M. Defays (of the Belgian National Committee), entitled "*Influence of the Use of the Heavy Oil Engine on the World Economy of Combustible Fuels*," dealt with advantages of the heavy oil engine, particularly the high-speed engine. The author divided engines into three classes—low-speed, below 500 r.p.m.; moderate speed, 500 to 1000 r.p.m.; and high speed, over 1000 r.p.m. Brief reference was made to the Beardmore, M.A.N., Benz, and Junkers moderate-speed engines, and the Held-Rallye engine, designed by Mr. Held, who was formerly in charge of the light engine work at Nobel's factory. This engine had a designed output of 20 B.H.P. at 2000 to 2500 r.p.m., and a fuel consumption at 1700 r.p.m. of 280 grams of oil, with a 10 per cent. tolerance. An aircraft engine of this type, capable of developing 600 horse-power, and weighing only 700 kilogs., was under construction.

A further paper by Professor E. Hubendick on "*The Use of Heavy Oils in Internal Combustion Engines*," dealt principally with a series of tests made on a 65 B.H.P. four-cycle two-cylinder oil engine of the Hesselman type. The Hesselman fuel injection system was described, and it was claimed that a thick distillation residue could be successfully utilised with airless injection.

Foremost in the three papers dealing more particularly with engine operation and design was Dr. W. Riehm's paper on "*The Present Position of the High-speed Automobile Engine*." After setting out the properties of a fuel suitable for use in automobile engines of the high-speed Diesel type, the author gave a brief description of the principal types of engine of this class which have been designed in Germany. The leading dimensions and weights are given in table I:—

TABLE I.—*German High-speed Diesel Automobile Engines.*

Type of engine.	Designed output, B.H.P.	Number of cylinders.	Cylinder bore, mm.	Stroke, m.m.	Revs. per min.	Fuel consumption, grms. per B.H.P. hour.	Weight in kilos.
Maybach 4-stroke air injection	150	6	140	180	1300	175–190	1260
M.A.N. 4-stroke airless injection	60	4	120	180	1200	175–190	530*
ditto ditto	180	6	165	220	1000		1550
Dorner 4-stroke airless injection	35	4	95	160	1000	210	—
Junkers opposed piston airless injection	45	2	80	150	1000	180	280*
Daimler-Benz 4-stroke aux. chamber airless injection	70	6	105	165	1300	200	—
Körting 4-stroke aux. chamber airless injection	90	6	130	180	1200	210	1500
Deutz 4-stroke aux. chamber airless injection	60	4	115	170	1500	185	700
Mannheim 4-stroke aux. chamber airless injection	250	6	200	250	1000	—	3200*

* Without flywheel.

Figures were given showing that the consumption of such engines is only from 62 to 66 per cent. of that of petrol engines, which, assuming a good grade of gas oil to be employed as fuel, meant a saving in cost of fuel of 40 per cent. One of four lorries in Augsburg had now covered 50,000 kiloms. without requiring special overhaul. The use of such engines for railway work and various systems of transmission was also discussed, as well as other uses at sea and on land.

In a paper on "*Diesel Engines Fitted with Exhaust Turbine Superchargers*," Mr. A. Büchi (of the Swiss National Committee), dealt with supercharging by means of a turbo-blower, driven by the exhaust gases. In the first part of the paper theoretical principles were discussed. An interesting section was that devoted to the scavenging effect of the charging air. The author recommended such a valve timing as would give an appreciable overlap between the opening of the air inlet valves and the closing of the exhaust valves. By such a means the weight of air in the cylinder was increased, and better cooling of the piston, liner walls, and the exhaust valves ensured. This cooling to a large extent compensated for the increased flow of heat arising from the larger heat volume and the higher initial air temperature. The later part of the paper dealt with an extensive series of tests which were made by Professor A. Stodola, of Zürich University, on a six-cylinder, four-stroke Diesel engine, designed to develop as an ordinary engine about 850 B.H.P. at 169 r.p.m. The cylinders had a diameter of 560 mm. (22 1/16 in.) and a stroke of 640 mm. (25·3in.). This engine was fitted with an exhaust

turbine and blower built by Brown, Boveri and Co., of Baden, Switzerland, which ran as the load was varied from 100·5 up to 1630 B.H.P., at speeds from 2120 and 6178 r.p.m., the turbine speed increasing automatically as the load on the engine was raised. At the lower power the delivery pressure of the blower was 0·355 lb. per square inch gauge, with 7·11 lb. at the higher power. The air intake temperature varied from 76·8 deg. to 171·8 deg. Fah., and the exhaust temperature from 271·4 deg. to 833 deg. Fah.

When the engine was developing 1253·5 B.H.P. the heat carried away by this cooling water was found to be 927 B.Th.U. from the cylinder head and jacket, which figure was less than the loss from a similar Diesel engine of half the designed power. The temperatures at the inlet to the turbine varied from 417 deg. to 1011 deg. Fah., and were much higher than those behind the exhaust valves, as the valves were cooled by the scavenged air. Behind the turbine the temperatures varied from 310·8 deg. to 841·8 deg. Fah.

The tests showed that a 50 per cent. increase of power could be obtained due to the supercharging and less cooling water was required. Other advantages of an exhaust turbine supercharged engine were lower fuel consumption and lower lubricating oil consumption due to the pistons and bearings being smaller than for an ordinary Diesel engine designed for the same output. The overload capacity was also considerable, as the blower pressure automatically increases with the load. There would also appear to be a considerable saving in weight.

An interesting contribution to the large existing literature on Diesel locomotive practice was presented by Mr. P. Yanouschevsky (Russian National Committee), in a paper entitled "*Experiments with Diesel Engine Driven Locomotives on Russian Railways.*" It dealt with the performance of three 700 to 900 B.H.P. Diesel locomotives, which have been employed in Russia since 1925, and run in goods train service. The first locomotive described was that constructed by Professor J. M. Hackel in Russia in 1924. It was provided with a 700 to 1000 B.H.P., 395 r.p.m., ten-cylinder, airless-injection engine of the Vickers submarine type, which drove two generators. A large battery equipment was carried to enable one generator to be used as a starting motor. This locomotive weighed 160 tons, and was designed for a speed of 16 kiloms. per hour, and tractive effort of 15,000 kilos. Owing to the great adhesive weight, however, tractive efforts up to 32,000 kilos. could be obtained. Experiments showed that the engine's vibrations were negligible, and that no body springing was required. The traction motors, of which there were ten 100-kW units, were placed over the underframe to facilitate inspection and repairs.

The second locomotive referred to by the author was described in THE ENGINEER of September 19th and November 14th, 1924, and its road tests were published in THE ENGINEER of February 22nd, 1925. This locomotive was built to the designs of Professor Lomonossoff. It was of the Diesel-electric type, designed for a tractive effort of 15,000 kilos. and a speed of 16 kiloms. per hour. The engine was a six-cylinder M.A.N. unit with air injection and of a designed output of 700 to 1200 brake horse-power at 300 to 450 revolutions per minute. The power was transmitted through five motors of 142 kW rating.

The third locomotive, built by the Hohenzollern Company, of Düsseldorf, was provided with a similar Diesel engine, but the power was transmitted by gearing and magnetic clutches. There were three change gear ratios of 6·923, 3·966, and 2·053 respectively, enabling the speed and tractive effort to be varied. A full description of this locomotive was given in THE ENGINEER of July 29th, 1926. These last two locomotives have been in service between Moscow and Baku. Compared with steam locomotives, the fuel used was in the ratio of 1 to 4 for the Diesel-electric locomotive and 1 to 4·5 for the Diesel geared engine.

With regard to the geared locomotive, comment was made on the fact that the main magnetic clutch must be slipped before changing speed, and that in the early experiments several coupling breakages took place when starting. These were attributed to the small gear ratio of 6·9 in the first step, which necessitated the slipping of the main clutch. The author gives in Table II. a comparison in cost based on Chervonny roubles between Diesel and steam locomotives.

The experiments were being continued, and different systems of transmission were to be tried out with new types of oil engines, specially adapted for locomotive work. A very full bibliography was attached to this paper, giving no less than 295 references to articles dealing with oil engine locomotive work.

After the general report on the papers above referred to had been presented by Mr. O. Thornycroft, the chairman called upon Mr. H. R. Ricardo to open the discussion.

Mr. H. R. Ricardo remarked upon the very wide range of subjects covered, which embraced the field of both petrol engine and high-speed Diesel engine design and operation. With regard to starting problems, a beginning had been made with jacket heating, electric starters, and cartridge ignition, but he felt that in the future more would be done. The question of smell was bound up with the formation of intermediate products of combustion in the thin layers near the cylinder walls. There were two lines of attack, namely, those of engine design and fuel treatment. A point which had to be borne in mind when advocating heavy fuel oils for motor and lorry use was the fact that fuel oil tended to creep over surfaces, and did not dry off as petrol did. That was a serious disadvantage. There was undoubtedly an advantage in favour of the heavy oil engine with respect to fuel cost, but it was heavier. An 80 B.H.P. lorry engine of the Diesel type ran at 2000 to 2500 r.p.m., with a brake mean effective pressure of 110 lb. to 120 lb. per square inch, and consumed 0·5 lb. of fuel. Its weight was 9 lb. to 10 lb. per B.H.P. With regard to design, he thought that the petrol engine was well in advance except in the matter of fuel consumption. He noted that in the engines referred to in Dr. Riehm's paper the balance was held between engines of the normal type and the auxiliary combustion chamber type. Although the provision of an auxiliary combustion chamber provided a means of mixing the fuel and air intimately, there was a heat loss of the order of 10 per cent. In his own opinion, the auxiliary chamber engine, like the hot-bulb engine, was only a passing stage in the progress of design, and would be discarded as the art advanced.

With regard to Mr. Büchi's paper on Supercharging, he recalled the work done for the past twelve or thirteen years on aeroplane engines, with a not unqualified success. In a well-designed engine the advantages of supercharging were small, and he did not see how the efficiency could be greatly improved or the heat flow reduced. Trouble had been experienced with the long uncooled exhaust pipes, and this was an important factor. He congratulated the Russian engineers on the courageous way in which they had tackled the main line locomotive problem. That was a field in which the internal combustion engine might have been expected to do particularly well, as in a steam locomotive the water carried was about ten times the weight of the fuel. Far too much mystery had surrounded the problem of transmission systems, which had been overcome in military tank design. The chemists had done much to adapt fuels to meet the needs of the petrol engine, but more might be done in engine design. With the continual "doping" there was a real danger that the petrol engine might become neurotic.

Professor F. W. Burstall referred to his own experiments on the combustion of pure gases in a circular bomb, which had thrown some light on the complicated phenomenon of combustion. He did not regard the mere injection of the fuel as sufficient. Chemical changes undoubtedly took place before combustion started with the freeing of volatile constituents, which aided ignition and combustion. Hot-bulb practice bore out this same idea. In tests which he had made traces of CO and hydrogen had been found in the exhaust gases, and by condensing the gases from an oil engine running at 300 to 400 r.p.m. he had been able to detect unburnt fuel. He was of opinion that designers should direct their efforts towards completing combustion in a reasonable time, say, half a stroke. Scientific research was required, and on this particular subject pure science was lagging behind the commercial application.

TABLE II.

	Steam loco.		Diesel loco. No. 2.		Diesel loco. No. 3. (geared).	
	Per 100 kiloms.	Per 10,000 t.n kiloms.	Per 100 kiloms.	Per 10,000 ton kiloms.	Per 100 kiloms.	Per 10,000 ton kiloms.
Crew wages	29·70	3·32	34·50	4·08	37·50	4·28
Fuel	46·65	5·21	18·40	2·18	17·30	1·97
Light	0·80	0·01	0·25	0·03	0·13	0·01
Lubrication	1·43	0·16	4·16	0·49	4·15	0·47
Cleaning	2·32	0·26	0·78	0·09	1·21	0·14
Small repairs	8·51	0·95	12·23	1·45	10·53	1·12
Water supply	4·42	0·49	0·04	0·01	0·04	0·01
	93·11	10·40	70·36	8·33	70·91	8·02

Major A. G. Beaumont said that he was specially interested in the high-speed heavy oil engines mentioned in Dr. Riehm's paper. Apart from such engines, it had been found possible to burn gas oils with a special type of vaporiser, using petrol for starting and light running. The heavy oil engine had introduced new factors in the fuel pump, and the necessity for a large starting motor. In the Mercédès-Benz design of engine, in which he was interested, it had been necessary to provide in the design of the chassis for additional tensile stresses caused by the heavy flywheel. The electric starter was also a bulky addition. With regard to Mr. Ricardo's remarks on doped fuels, he thought that the question of overhauls had been overlooked. With special fuels the period before it was necessary to overhaul had been prolonged, and if anti-knock substances were not costly, it might pay to use them.

Mr. I. Lubbock dealt principally with the question of Diesel locomotive pra tice and instanced the present wide application of the Diesel rail car in all countries. The 1000 B.H.P. locomotives described in the Russian paper were a stepping-stone to the 2000 to 3000 B.H.P. units required for main line work. The results quoted of a fuel weight ratio compared to steam of 4 : 1 and 4·5 : 1 were not so good as Canadian National Railway and Swedish and Swiss results.

Mr. W. A. Tookey spoke on the question of the corrosion caused by exhaust gases, and referred to the simple expedient of draining the pipes and silencers, which was adopted twenty to twenty-five years ago by gas engine makers and users. He said that the problem of smell would disappear with complete combustion. Further effort, he thought, might usefully be employed in enabling petrol engines to work at higher compression ratios. Supercharging certainly seemed to increase the engine output and increased the heat extraction of the wall surfaces.

Dr. G. Egloff made references to the use of chromium-plated pipes, 16 per cent. chrome iron and steel pipes and linings of cement, which had been successfully employed in refinery practice to combat the effect of sulphur and derivative acids. In visiting this country and Germany, he had noted that a higher sulphur content in petrol was permitted than was used in America, where the standard was 0·1 per cent. If that standard could be raised to 0·3 per cent., as in Germany, then refiners would benefit considerably. He had examined over 200 samples of anti-knock compounds marketed in America, and found many useless and even knock accelerators.

Mr. W. A. Whatmough spoke in favour of more attention being paid to engine design. He thought that there had been too much sectionalisation on the chemical and physical aspects of the combustion problem. Detonation in tube experiments was not the same thing as engine knock, the experiments on spontaneous ignition temperatures had shown good results, as had those on flame travel. He mentioned an engine which he had specially designed, in which by careful attention to sparking plug position and combustion chamber design, it had been found possible to work at a compression ratio of 6·5, with ordinary petrol. The engine would take full advance on heavy load and knocking only occurred with increased speed.

Mr. M. Gercke, replying for Dr. Riehm, said that development work in connection with the high-speed heavy oil engine was going on. No difficulty had been met with in starting, a motor starter with a large battery being employed. A small alcohol burner for warming up had been fitted, but was not generally used. With regard to smell from the exhaust, these automobile engines were recommended for long cross-country routes, and the question did not arise in such cases. He thought that the carburetter type of heavy oil engine had now been abandoned.

THE SAMPLING AND TESTING OF SOLID FUELS.

On Tuesday afternoon Section B met in the large hall to discuss five papers dealing with the sampling and testing of coal. In the absence of Professor J. W. Cobb, the chair was taken by Mr. F. Sinnatt. The question of sampling was given much less attention than that of testing by the authors of the papers, and was indeed hardly dealt with at all except in a contribution on "*The Sampling and Testing of Coal,*" contributed by the Austrian Heat Economy Society. It is sufficient to say that the procedure recommended for sampling differed in no important respect from that usually followed. For large consignments a sample of 50 kilos. per 10,000 kilos. was considered adequate, the proportion being that of 1 cwt. per 10-ton truck, or one-half of 1 per cent. Mr. R. Vondrácek, of the Czechoslovakian National Committee, contributed two papers dealing respectively with the determination of volatile matter by low temperature methods, and the other discussing the hygroscopic qualities of coal. Mr. Stanislaw Felsz, of Poland, argued for the idea of a "standard" coal as regards calorific value, with which actual coals could be prepared. He proposed that a clorific value of 6320 calories (11,376 B.Th.U. per pound) should be taken as a standard, being a fairly representative value and simplifying calculations if the total heat of steam were taken as 632 calories per gramme and the thermal equivalent of 1 horse-power hour as 632 calories. The theoretical evaporation per unit weight of standard coal would then be exactly one-tenth of the percentage efficiency of the boiler. As regards proximate analysis, the method recommended by the Austrian Society for determination of moisture consisted in putting 30 to 50 grammes of coal into a flask with 200 c.c. of Xylol. The Xylol was distilled off and the water carried over with it was condensed and weighed. This method was given preference over the usual way of heating the coal to 105 deg. Cent. in an oven and noting the loss of weight, on the grounds that in the latter procedure errors might arise by the oxidation of certain coals. For determining volatile matter the Austrian method was similar to that common in America, namely, heating the coal in a platinum

crucible to about 900 deg. or 950 deg. Cent. for seven minutes and noting the loss in weight. With some fuels errors occurred, due to partial combustion of the sample when driving off the volatile matter, but this could be avoided by heating the sample in an inert gas, the practice adopted in the case of the Austrian brown coals. The determination of the amount of ash in coal, by the usual method, though simple, was not altogether satisfactory, as the ash was oxidised in the process. This oxidation of the ash constituents caused difficulties in connection with the determination of the oxygen in the fuel, and a good direct method of estimating oxygen was urgently required in place of the usual difference method.

A question which most engineers in this country regard as happily settled was reopened by a paper entitled "*The Use of Gross and Net Calorific Values for the Purpose of Guarantee Tests*," contributed by Mr. N. F. Nissen (Germany). The author mentioned that in Germany for the past two years it had been the custom to report boiler efficiencies on both the gross and the net values of the fuel. The gross value assumed that the initial and final temperatures of both fuel and products of combustion were 0 deg. Cent., while the net value assumed that the water vapour was cooled to the dewpoint only. He maintained that experience showed that efficiencies based on the gross value were unsatisfactory and that the net value should be used.

Dr. A. Parker, who had presented a summary of the papers, was called on by the Chairman to open the discussion. Speaking of the sampling of coal, he pointed out that large and small pieces ought to be found in the sample in the same proportion as in the bulk, as size affected ash and moisture content. The American test for volatile matters was satisfactory for bituminous fuel, as the gases passing away prevented oxidation of the sample; but for fuels like coke some other method would be preferable. As regards the question of calorific values, he thought the net value was the one of most use in boiler practice; but in carbonisation work it was meaningless and the gross value was imperative. Mr. Le Maistre, Secretary of the British Engineering Standards Association, regretted a resolution passed at the morning session, to the effect that international action should be taken with regard to standards of testing. The question of standard methods was only 15 per cent. technical and 85 per cent. commercial, and it was no good putting up scientific standards before the commercial people would accept them. We should put our own house in order before attempting an international understanding. The B.E.S.A. had several committees working on the subject and were in full touch with competent opinion. Signor Forte, of the Italian State Railways, objected to the proposed "standard" coal on the grounds that 6320 calories was not typical of the coals used on Italian, German, or Swiss railways, which ran from 7800 to 8000 calories, and also because the total heat in steam was not constant at 632 calories, but depended on pressure and temperature. Mr. Himus, of the Imperial College of Science, described the method there used of determining moisture in coal by putting the sample for one and a-half hours in a steam-heated vacuum oven at 100 deg. Cent. and noting the loss in weight. No oxidation took place even after long heating under these conditions, and the method was preferable to that in which Xylol was used. At the Imperial College of Science volatile determinations were made by heating a sample of coal in a silica tube in the presence of its own gas. The results were very consistent, repeated tests on a coal with, say, 30 per cent. volatile never exceeded the range of 29·9 to 30·1 per cent.

Mr. de Waard (Holland) favoured the use of the higher or gross calorific value of coal. Mr. H. P. Cronshaw described a quick and easy way of sampling coal in bulk by driving a 2in. or 3in. pipe into the heap at intervals and mixing the samples withdrawn by the pipe. Mr. A. Worsley spoke of the readiness with which lignites lost their moisture in a dry climate, so that the consumer might receive coal of a very different analysis from that obtained at the pithead. He advocated two standard methods of analysis—one for ordinary coals and one for lignites. Mr. Zur Nedder, of the German National Committee, mentioned that Dr. Rosin had asked him also to advocate a different method of analysis for lignite coals, as that suitable for ordinary coals might give very erroneous results on account of the tar formed. With regard to international action, the time had hardly come for agreement to be possible on many points; but at least the question of the higher or lower calorific value might be settled internationally. In the name of the German Committee he moved a resolution that the International Council should be urged to arrive at some agreement on the subject.

The Chairman said the point had better be dealt with at once, and to enable it to be discussed Mr. Le Maistre seconded the resolution, offering on behalf of the B.E.S.A. to submit an interim report on the subject. Dr. Lessing supported the idea that the work of the B.E.S.A. committees should be presented as an interim report to other countries, but Dr. Smith could not accept the suggestion, as the International Executive should be left to decide how it would deal with the matter. Mr. W. M. Selvey gave a practical turn to the discussion by reminding the meeting that, whatever resolution they passed with regard to the perfection of testing methods, the everyday work had to be carried out by busy practical men. As to sampling, he was satisfied that there was no scientific method of getting a sample which was commercially practicable, and no practical method which would satisfy a scientific man. However, if we could only agree on some methods of testing which would give consistent, even if not scientifically accurate, determinations of water, sulphur, and ash in coal it would be most useful. Speaking on the subject of calorific values, Mr. Selvey reminded the members of a fact which seemed quite unknown or forgotten, namely, that the Heat Engine Trials Committee, representing practically all the engineering institutions and societies in Great Britain, had decided that the gross calorific value should be used. Previous to this decision the use of the net value was frequent, and German and American engineers had laughed at our departure from the simple and absolute gross value in favour of a value which could be calculated in dozens of different ways with different results. As a practical man, with twenty years' experience of the subject, he detested the idea of any reversion to the net value.

Professor Carlo Padovani (Italy) remarked on the difficulties of making accurate determinations of moisture for the low-grade fuels and lignites found in Italy. He had found out that the method of heating the sample in a current of nitrogen was much more satisfactory than either the Xylol or the simple heating method, and he hoped that the nitrogen method would be standardised. To this end the Italian Committee would place all their data at the disposition of the Conference. Mr. H. Van Hetting Tromp (Holland) referred to the desirability of some standard test for determining the liability of coals to spontaneous combustion. The test he proposed had been used with complete success for many years in the Dutch East Indies, where the coals were liable to ignite spontaneously. It consisted in placing a powdered sample of the coal to be tested in a U tube immersed in an oil bath and passing a current of oxygen through it. The temperature of the coal would rise and therefore that of the oil bath. The rise in temperature in a given time was a measure of the liability of the coal to ignite spontaneously. He recommended the method for adoption in all countries where spontaneous ignition was a difficulty.

Composition, Classification, Preparation, Storage, and Handling of Liquid Fuels.

On Tuesday afternoon a group of twelve papers bearing upon the above subjects were discussed under the chairmanship of Sir Thomas Holland. The papers were almost all of a chemical nature and reflected the interest now being taken in the subject of cracking by the oil industry. The cracking process represented the greatest advance made by the industry during recent years, the development having taken place almost entirely in America, where the necessity for supplementing straight-run gasoline first became evident. Vapour phase processes were first adopted, but the full development of this type of cracking was abandoned in favour of liquid phase processes on account of the practical advantages of the latter. The immense quantity of cracked gasoline now on the market was produced by liquid cracking, and had assisted in the development of the motor transport industry while at the same time helping much to conserve the world's resources of petroleum. The difficulties in the development of modern cracking plants had been largely overcome. Fuel economy had been realised by improvements in furnace construction, preheating of air supply, and the use of hot oil pumps. Standardisation of construction, automatic control, and better instruments had all helped to lower working costs and to improve operating conditions. The commercially successful processes relied on heat treatment only to effect cracking, heating coils and reaction chambers being generally used. Vapour phase cracking had received more attention during recent years on account of the high anti-knock property of the gasoline produced, although this was only one of its characteristics. The primary use of the cracking process up to the present time had been the conversion of hydrocarbon oils into motor fuels. Great as this achievement was, it did not represent the full possibilities of cracking. The cracking process could convert any liquid carbonaceous material into practically any hydrocarbon product. From these latter a host of other materials could be obtained, including alcohols, glycols, paint thinners, solvent oils and lubricating oils, besides asphalt from the residuum. The flexibility of the cracking process was such that the operations could be controlled so as to give the maximum yields of the hydrocarbons desired. The paraffin hydrocarbons were now principally used as fuels, and work was urgently needed to develop means of converting them to useful derivatives. The diolefines present in cracked products, were of great potential value, and, being closely related to the rubber hydrocarbons, might assist in the production of synthetic rubber.

(To be continued.)

CONSIDERABLE satisfation is being expressed in Southampton by the announcement of the North German Lloyd that when its new steamers are ready they will call at Southampton instead of Plymouth on the homeward journey. The Southern Railway will also be a gainer at the expense of the Great Western.

The Wireless Exhibition.

ON Saturday, September 22nd, the Wireless Exhibition was opened at Olympia. Since the last Exhibition marked improvements have been made in the design and construction of receiving sets, and component parts. New valves, loud speakers, battery eliminators, &c., have also been introduced, and no one who visits the Show can complain of lack of originality. Although demonstrations are not made in the Exhibition itself, quite a number of firms are operating loud speakers, &c., in shops and private houses in the immediate vicinity. For the first time in this country, public television demonstrations are being given by the Baird Television Development Company, Ltd., and we are glad to be able to report that the performance of the latest television receivers is satisfactory. When we visited the company's offices about eighteen months ago and witnessed a demonstration of the experimental apparatus, we had doubts as to whether the system would ever become a commercial success. The images were blurred and indistinct, but since that time Mr. Baird has improved the apparatus immensely. Persons at the transmitting end are easily recognised at the receiver, and all movements of the face and hands are quite distinct. In spite of all the adverse criticism which Mr. Baird has met with, he has apparently justified his claims; at any rate the demonstrations he is now giving are a very marked advance on anything we have previously seen. Television sets, or "Televisors" combined with loud speakers, so that singers or speakers can be both seen and heard, are to be seen in operation.

Whether the recent decisions of the Comptroller of Patents have had anything to do with prevailing prices of wireless receivers, we do not know, but the fact remains that on the whole the receivers appear to be appreciably cheaper than they were last year. In all probability the reduction in price has been mainly brought about by the increased demand for wireless apparatus, and by the more extensive adoption of mass production. Another noticable feature of the Show is the tendency to simple wireless receivers and to make it an easy matter for people to construct instruments themselves. For the benefit of those who are anxious to construct a wireless receiving set, but who have had no experience in the use of tools and who find soldering a troublesome job, the Igranic Electric Company has introduced a scheme which overcomes all the difficulties. The base on which the component parts of a three-valve set are mounted is already drilled, and all the constructor has to do is to place the parts in position in accordance with a picture with which he is supplied. When all the components have been fixed to the base board, a so-called wiring panel, on which all the wiring connections have already been made, and in which there are holes corresponding with those in the base, is placed under the base, so that the projecting screws belonging to the components fit into the holes, and when nuts have been placed on the screws and tightened up, the receiver is practically complete. In order that the constructor may also claim to have made the metal case, it is supplied in several parts, which are easily joined together by means of small screws. We recently saw one of these sets assembled by a girl who had had little or no previous experience, and the whole job was completed in about forty minutes. The circuit of this so-called "Igranikit" receiver comprises a single high-frequency amplifying stage, a detector valve and a single low frequency amplifying stage. A power valve is recommended for the last stage or when greater volume is required a "Pentode" valve. The receiver is designed for operation either with high and low-tension batteries housed in a cabinet forming a pedestal base for the receiver or with a main supply unit.

The new "Pentode" valve, which has been designed for improving low-frequency amplification and which will do the work of two ordinary valves, is creating a considerable amount of interest. It is a power-output valve, with two additional grids, one of which is connected to the filament, whilst the other is connected to a terminal on the side of the valve base. It has a four-pin base, and fits into an ordinary valve holder, the only addition being a flexible lead from the terminal on the valve base connected to the same positive high-tension battery terminal that is used for the normal anode connection. To obtain good-quality loud-speaker reproduction, the valve in the output stage of a receiver must be capable of passing a large anode current, and should also have as high a mutual conductance as possible. In order that a normal three-electrode valve may carry a large anode current, the internal impedance has to be low, and this causes the amplification factor to be low. But by reason of the provision of two extra grids the "Pentode" valve is capable of carrying a large anode current, and it also has a very large amplification factor—in the case of the Mullard 4-volt P.M. 24 valve, the amplification factor is no less than 62; whilst the mutual conductance is also considerably greater than usual. The valve is consequently very suitable for use as an output valve, and will give an amplification equivalent to that obtainable with two low-frequency stages employing normal low-frequency and super-power three-electrode valves. The valve is claimed to be of great advantage when a

receiver is used in a spot a long distance from a transmitting station and when the output of the set is insufficient to work a loud speaker satisfactorily. Many wireless manufacturers are taking advantage of the properties of this new valve, and in some cases it is being employed in portable receivers where saving in weight and increase in efficiency are matters of vital importance. The screened four-electrode valve, which was one of the main attractions at the previous Exhibition, is shown in an improved form.

The latest developments in short-wave receivers are particularly noteworthy. Some of them now have a high-frequency stage, which has been made practicable by the screened grid valve. Several manufacturers are exhibiting receivers which are not only efficient on the ultra-short-wave lengths, but which also give excellent results on the broadcast and long wave length bands. With short wave receivers, it is possible to receive signals from transmitters situated very many miles away; it is said, in fact, that since the establishment of the 24-m. station at Chelmsford, the transmission from that station has often been picked up in the Colonies.

As far as components are concerned, the general tendency is towards improved quality and performance, combined with lower prices. The shoddy goods that were placed on the market in the early days of broadcasting have to a large extent disappeared, and such things as variable condensers and resistances are now made on much sounder lines than they were in the past. Within recent times real skill and ingenuity have been brought to bear on the design and construction of wireless apparatus. Although there has been much discussion concerning the relative merits of low-frequency transformer couplings and resistance capacity couplings, and some have gone so far as to say that the latter would eventually wipe the transformer out of existence, both forms of coupling continue to hold their own. Many manufacturers and amateur constructors use a stage of each. Research and experience have shown manufacturers how to construct intervalve transformers that will give good results, and much that has been said against the use of transformers can no longer be substantiated. At the present Exhibition many makes of intervalve transformers are to be seen. A new small and neat low-frequency transformer is shown by the Igranic Electric Company for the first time, and it is claimed to give amplification comparing favourably with the heavier and more expensive types. Another firm showing a good collection of transformers, including output transformers and push-pull transformers, is Ferranti, Ltd., of Hollinwood.

Moving coil loud speakers are far more prevalent than they were last year. The instruments on view demonstrate the headway made in design and construction, but whether this type of loud speaker will come into general use remains to be seen. Altogether, the Exhibition is a very excellent one, and well worthy of a visit.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

IS STATIC BALANCING OF ROTORS SUFFICIENT?

SIR,—In your issue of September 14th, 1928, Dr. Hans Heymann is gratuitously, though perhaps kindly, concerned about "the detriment of British industry" that might follow from Professor B. P. Haigh's articles in THE ENGINEER of last March 23rd and 30th. Dr. Heymann is no doubt aware of a paper by Dr. H. Hort in the *Elektrotechnische Zeitschrift*, Vol. 43, June 29th, 1922, pages 883–885, suggesting with laborious care that static balancing is all that is needed for most purposes. The fact that Dr. Hort's company has since developed a combined static-dynamic machine may be regarded by Dr. Heymann as a point in favour of his argument, but it does not in the least invalidate the reasoning in Hort's paper.

Having devised two dynamic and two static machines, some of which are in daily use in up-to-date factories, I am perhaps qualified to state that the argument between advocates of static and of dynamic balancing is often both futile and fatuous. Both systems have advantages, and both are sometimes quite unnecessary. One leading continental firm, making high-speed engines, uses no balancing devices, static or dynamic, for crank shafts.

The figures given, rather vaguely, by Dr. Heymann for the 5-ton rotor, indicate a static unbalance of about 350 grammes at 1 m. radius. This is equivalent to an excentricity of the centre of gravity equal to about 0·07 mm., which would be easily detected by the worst static balancer on the market. Or if the 400 grammes were at a smaller radius, an excentricity of about 0·035 mm. is indicated, which is still well within the capacity of any properly adjusted static balancer. I have had experience with the Lawaczeck-Heymann, as well as with the Olsen, Norton and Gisholt machines, and I have found errors in the work produced by them, but this is not to suggest that the machines were faulty either in design or construction. Much depends on the time and care taken by the operator, and because Dr. Heymann found a statically balanced rotor in statical unbalance, he is not justified in condemning a simple, much-used process so sweepingly.

In conclusion, it is perhaps permissible to point out, without implying any possible detriment to German science, that Dr. Heymann should not confuse a "force-cross" with a "couple." The two things—Kraftkreuz and Kräftepaar—are, as the names denote, distinctly different force systems.

H. S. ROWELL,
Director of Research, R.A.B.M.A.M.
Chiswick, W. 4, September 21st.

THE RECOVERY OF WASTE HEAT.

SIR,—I have read with interest "M.I. Mech. E.'s" letter in last week's issue of THE ENGINEER commenting, amongst other things, on my recent remarks on the above subject, following your editorial of the 24th ult.

Confining my remarks to iron and steel works practice, the situation in this country is that with a properly organised system of waste heat recovery, plus effective utilisation of the surplus industrial gas, the necessity for fuel-fired boilers for power, &c., purposes disappears, and this is what we are aiming at for our clients. In our opinion, it represents one of the main factors for combating foreign competition.

We have always emphasised the fact that proper utilisation of the steam is of equal importance to its effective generation, and for obvious reasons such schemes must of necessity involve "mixed" prime movers, but the question as to whether the mills themselves are direct steam driven or electrically driven is really a very small factor in the whole scheme, and the above-stated economy in fuel can be obtained with either arrangement.

Furthermore, one has to remember that completely to electrify the average British mill, already equipped with a comparatively modern steam drive, would involve capital expenditure at the moment beyond the purse of the British steel-making industry.

On the other hand, operating on the lines outlined above, the desired degree of fuel economy is obtained with comparatively small capital outlay.

I can assure your contributor that we do not in any way belittle American or continental practice, and that we make every effort to be fully conversant with foreign methods and research, but it is always necessary to keep well to the fore the conditions peculiar to British requirements.

W. GREGSON,
Chief Engineer and General Manager,
Spencer-Bonecourt, Ltd.
Westminster, S.W. 1, September 25th.

Signals for Motor Traffic.

IN towns and busy centres of population the control of motor traffic is most effectively carried out by the aid of the police and accidents due to collisions at busy crossings are probably less frequent than those which are caused on main roads by motor vehicles emerging from side roads unexpectedly. It is, of course, too much to expect police control in such cases. One way to prevent accidents from this cause is to substitute for fixed danger signs automatic signals which, although normally inoperative, indicate danger to the users of the main road when a vehicle is about to emerge from the subsidiary road. Such signals, to be effective, must be given sufficiently in advance to permit motorists on the main road to slow down and be prepared to stop altogether if necessary, while after the vehicle has entered the main road the signal should automatically return to normal. A system of control of such signals is now being introduced by Switchgear and Cowans, Ltd., Old Trafford, Manchester, the inventor being Mr. J. E. Waller, a director of that company. The apparatus consists of a lamp-post, erected at the junction of a main and an inferior road, containing red and green lamps arranged so that normally a red light or "danger" is shown to the side road traffic and a green light or "caution" to the main road traffic. With the approach of a vehicle in the side road the red light in the side road changes to green and the green light on the main road changes to red.

The change of the lights from "danger" to "caution" on the side road and from "caution" to "danger" on the main road is effected by the vehicle on the side road depressing a road plate normally held by springs slightly above the road surface and situated at a convenient distance from the junction. By means of a rod and crank mechanism placed below the ground the depression of the road plate operates a switch in a box in the footpath. This switch closes an electric circuit and energises a solenoid contained in the base of the lamp-post. The upward movement of the solenoid core operates a switch, changing the lights from "caution" on the main road and "danger" on the side road to "danger" on the main road and "caution" on the side road. The solenoid having only been momentarily energised, the core, being retarded by means of a time lag device, descends gradually for the required time, and when it has fully descended the lamps are again changed to normal. As an additional warning a syren or gong can be attached to the lamp-post and electrically operated at the same time that the danger signal is shown on the main road.

If it is not desired to have the lights burning in the normal condition a switch is provided which can cut out the lights so that the "danger" signals on the main road and the "caution" signal on the side road are shown only when a vehicle on the side road approaches the junction. Provision is also made to cut out the syren or gong from the circuit when desired, as, for instance, at night, when the junction is close to a habitation. One arrangement of the system employs two road plates, parallel and close to one another, one of which is the signal-operating plate previously mentioned and the other plate acts as an isolator to prevent the signals from being operated unnecessarily by a vehicle entering the side road from the main road on the wrong side. The isolating plate being nearer to the junction than the operating plate, is depressed first in this case and immediately before the operating plate. This isolating plate is arranged to cut off current for a sufficient time to prevent it functioning till after the vehicle has passed over both plates. Consequently, when the road plates are depressed in this order—and in this order only—the signals remain at normal.

Apart from the first cost the expense of maintenance is comparatively small, the amount of current required being insignificant. In the arrangement which we saw under test at the maker's works the road plates project about ⅛in. above the surface and are contained in a metal framework flush with the road. Their vertical movement is very small and they are depressed by the weight of the lightest as well as the heaviest types of vehicle. In another form of apparatus for private drives the road signal is operated from a distance by the driver pulling a cord and switching on the electric current for a pre-arranged period of time.

SIXTY YEARS AGO.

IN our issue of September 25th, 1868, we recorded the launch of the steamship "Clio," by Leckie, Wood and Munro, engineers, of Aberdeen. The curious fact about the incident was that it was the third time the vessel had been launched. The "Clio," an iron vessel of 1800 tons measurement, was rigged as a three-masted schooner, and was fitted with engines of 130 nominal horse-power driving a screw. She belonged originally to Hull, and traded to Cronstadt and St. Petersburg. In December, 1866, she stranded in a fog and gale on the west coast of Jutland. She went ashore on a species of quicksand, and was left dry at low water. For sixteen months she lay neglected, and during that time she sank into the sand to a depth of 16ft. at the stern and 7ft. at the bow. The firm of engineers named above then purchased her, and in the spring of 1868 sent out a gang of men to undertake her salvage. A large platform of battens was erected on the sands round the vessel, and on this platform forty ballast levers and fifty screw jacks were placed at intervals. These levers and jacks acted on angle iron bracket frames girding the ship. The levers were 40ft. long and their fulcrums lay 5ft. from the side of the ship. At their outer ends ballast, stowed in bags, could be applied. At each lift the vessel was raised 2ft., and when she emerged from the sand all the accessible leaks were patched up. Finally, the ship was raised 6ft. clear above the sand and her bottom made tight. Launching ways were then constructed beneath her, and she was sent into the water broadside on. The vessel was then brought home, and after being hauled up and repaired throughout, was launched for the third time. We pointed out that the success of the lifting operation was to be ascribed to the use of a method whereby the reaction on the treacherous sand was diffused over a wide area. Had a few hydraulic jacks been employed instead of the comparatively clumsy levers and screws, the portions of the platforms in their neighbourhood would simply have been driven down into the sand. . . . In the same issue a note appeared which illustrates the fact that the mechanical setting of printers' type was even then in an advanced stage towards the development which it has since attained. We quoted a writer in the *American Artizan* to the following effect: "Among the many wonderful evidences of the ingenuity of mankind is the machine for setting and distributing type by electricity. This machine is now so perfected that I have before me a book containing 24,933 ems of solid matter, or 34,255 ems of leaded matter, the type of which was both 'set' and 'distributed' in six hours and thirty-nine minutes by the machine."

A HIGH POWER MOTOR BOAT ENGINE.

OFFICIAL tests were recently made at the Fiat Works, Turin, before a commission appointed by the Royal Italian Navy, on a new "M 900" type of high-power petrol engine, built for naval motor boat service. The unit tested has a designed output of 750 B.H.P. at 1940 r.p.m., with a propeller speed of 1700 r.p.m., and the maximum horse-power of 790 was developed at 2050 r.p.m. with a propeller speed of 1800 r.p.m. The dry weight of the engine is 3950 lb., and its fuel consumption is given as 0·55 lb. of petrol per horse-power-hour, in addition to which 0·02 lb. of lubricating oil per horse-power-hour is required.

The new unit consists of two six-cylinder engines, connected by gearing and mounted on a single aluminium base which forms both the crank case and the reverse gear housing. On the top of the gear casing is a column carrying all the controls and instruments. The cylinders each have a bore of 165 mm., with a stroke of 170 mm., and are cast in blocks of three, both the cylinders and jackets being made of cast iron The combustion chambers have flat tops with vertically arranged twin inlet and exhaust valves operated by two cam shafts. The valve gear is of the bridge type, generally similar to that which is employed in Fiat type aircraft engines. There are four double inverted carburetters, which are fed by pumps, and two ignition plugs are fitted to each cylinder.

The reversing gear and speed-reducing gear is of the Dohmen-Leblanc friction clutch type, with one ahead and one astern running clutch. These clutches, together with thrust bearing and the cardan joint for the inclined propeller, form a neat group at the front of the engine. Between the two crank shafts and the reverse gear shaft there are two vibration dampers of the fly-wheel type, the duty of which is to absorb crank shaft vibrations, and so protect the gear teeth. The auxiliaries include the usual lubricating oil and circulating water pumps, and arrangements are made whereby the engine can be started on compressed air which is operated from the control pillar.

ACCORDING to the *Goudok*, of Moscow, a length of more than 1000ft. of pavement on the Neva Quay at Leningrad was stolen. The thieves subsequently resold the granite to the Soviet Government.

Railway Matters.

THE sidings at Edge Hill, London, Midland and Scottish Railway, are to be improved at a cost of £50,000. Edge Hill was the original gravitational shunting yard.

OUT of 3139 engines owned by the Class I. railways of India, 1700 had been equipped with electric headlights by the end of March, 1927. Under a decision made early in 1925 by the Indian Railway Board, all locomotives, except those on branch lines, whether on double or single tracks, are to be equipped with electric headlights as a safety measure.

THE retirement of Mr. T. Knight, the district engineer at Leicester of the London and North-Eastern Railway, owing to his having reached the age limit, has afforded an opportunity to rearrange the Leicester and Derby engineering districts of that railway, and Mr. A. L. Newton, the engineer at Derby, is to have charge of the new division, with headquarters at Nottingham.

THE Ministry of Transport Railway Statistics for June also give the figures for the whole of the first half of the year. They show that, compared with January–June, 1927, there was an increase of 3·3 per cent. in the number of passenger journeys, of 0·8 per cent. in the receipts from passengers, of 0·3 per cent. in the total passenger receipts and of 3·8 per cent. in the passenger train mileage. On the other hand, all relevant figures as to freight traffic show decreases. There was a drop of 7·7 per cent. in the freight tonnage, of which 6·7 per cent. was in general merchandise and 7·3 per cent. in coal and of 7·1 per cent. in freight receipts, of which 4·8 per cent. was in general merchandise and 9·7 per cent. in coal. Freight train mileage was reduced by 2·9 per cent.

THERE was an unfortunate buffer stop collision at Charing Cross Station about eight o'clock in the morning of Wednesday, September 19th, wherein there was some considerable damage to the ends of two coaches. Forty-five passengers received medical treatment, of whom two had to remain in hospital until the evening. Following on the buffer stop collision of August 27th at Euston, the present accident has attracted more attention in the Press than it has warranted, and it has been remarked that this was the fourth such accident this year. As a matter of fact, there are, as can be seen from the annual returns of railway accidents, about sixty buffer stop collisions each year, wherein about 100 passengers are hurt. The characteristic feature—and the moral—in those accidents is that many passengers are standing ready to alight, and they lose their balance and receive injuries from which seated passengers escape.

THE Ministry of Transport Railway Statistics for June last have recently been issued as a Stationery Office publication, price 3s. 6d. The passenger figures were better than usual, particularly as the comparative month of June, 1927, included Whit Monday, which fell in May this year. The number of passenger journeys was 1·45 per cent. less than in 1927, of which 8·01 per cent. were at ordinary fares. The above-mentioned incidence of Whit Monday had the remarkable effect that there was an increase of 11·16 per cent. in workmen's journeys and of 10·33 per cent. in the receipts therefrom. Passenger receipts fell by 9·53 per cent., and, again owing to Whit Monday, even cheap fares were reduced by 12·15 per cent. The tonnage of freight traffic was reduced by 5·21 per cent. Coal traffic was down a little less than usual—4·44 per cent., as against 5·66 per cent. reduction in general merchandise —but the receipts from coal traffic fell by 11·05 per cent., and all freight traffic by 6·35 per cent. Freight train mileage was reduced by 1·79 per cent., but it moved more quickly, as there was an increase of 3·77 per cent. in the train miles per engine hour.

A VERY wise rule of the railway accidents branch of the Ministry of Transport, as it was of the Board of Trade when it dealt with railways, was revealed when the coroner resumed his inquiry into the London Bridge collision of July 9th. The inquest was opened on July 13th, and was adjourned for over two months, so as to have the benefit of the Ministry of Transport inspector's report when the matter was further investigated. On reopening the inquest on September 17th, the coroner stated that in reply to his request for a copy, the Ministry of Transport had replied that in such cases it had been the practice to withhold the reports of the inspecting officer of railways upon accidents until after the conclusion of the coroner's inquiry, or of any criminal proceedings that might be pending. "The practice in the contrary sense," added the Ministry, "would often involve serious unfairness, as at the inquiries by these officers into cases of accidents evidence is sometimes given which may be of utility in the public interest from the railway point of view, but which would not be given if the witness knew that his statement or conclusions based upon it might be used in legal proceedings."

ANOTHER page in railway history is being closed by the shutting down of the West Bridge branch of the former Midland Railway in respect of passenger traffic. It forms part of the Leicester and Swannington Railway, which was sanctioned in 1830, and opened on July 17th, 1832—four years before any main section of the Midland Railway was authorised. The Leicester and Swannington was built in order to bring coal from the Leicestershire coalfields to the river Soar at West Bridge, Leicester, and thereby secure advantages equal to those possessed by the Derbyshire and Notts. coalfields because of their water communication. In 1849 a connection from the Midland main line at Leicester to the Leicester and Swannington at Desford was built, which put the collieries at Desford, Bagworth, Bardon Hill, Coalville, and Swannington in connection with the main line. It, however, in a sense, isolated the line from Desford to West Bridge, 6¼ miles in length, with its intermediate stations at Ratby and Glenfield. On that line is the Glenfield tunnel, 1 mile 36 yards long, the small dimensions of which have always been a handicap, as instead of being the standard width of 9ft. and height in the centre of 13ft. 6in., it is only 7ft. 7in. wide and 12ft. 10in. high. As a consequence, among other inconveniences, special passenger carriages, with barred windows, have had to be used on the branch, and the necessity of renewing these coaches has led to passenger traffic having been withdrawn as from September 22nd.

Notes and Memoranda.

THE Royal Automobile Club announces that the Technical Committee will organise next spring trials of vehicles using fuels other than those coming under the common name of "petrol" (including benzol). If there is enough support a class will probably be introduced for solid fuels, such as coal dust.

FOR the last three or four years there has been considerable discussion on the advantages of cooling electric machines with hydrogen gas. The first unit of this type, a 12,500 kVA synchronous condenser, has been put into operation on the New England Power Company's system at Pawtucket, R.I. If the machine were air cooled its capacity would be reduced to 10,000 kVA. The machine is enclosed in a gas-tight explosion-proof cylinder.

IT is reported that the new German cruiser to be constructed at the Deutsche Werke, Kiel, is to be electrically welded, no rivets being used in any part of the ship. It is also understood that the armour plate used will be thinner than the usual battleship plate, made of a new alloy steel developed by Friedrich Krupp A. G. This steel will have the same resistance as that formerly used and will reduce the weight about 22 per cent., which is expected to permit greater speed.

IT is estimated that the annual consumption of glycerine in Japan amounts to approximately 4000 tons. Three firms each produces 250 tons of glycerine per year. There are a few small companies which produce limited quantities, bringing the total production in Japan to from 2200 tons to 2250 tons per year. Official statistics show that the importation of glycerine into Japan in the last three years was as follows:—1925, 1644 tons; 1926, 1430 tons; 1927, 1639 tons, valued at 1,865,092 yen. Great Britain supplies about 85 per cent. of these imports, and the remainder comes mainly from Germany and Japan.

MULCH paper, a product recently developed by the International Paper Company of New York, has been found greatly to increase the yield of various farm products, in some cases by as high as 500 per cent. Mulch paper is laid on the ground between the plants, or the plants are placed in the soil through holes made in the paper. It has proved very successful in Hawaii, and also in experiments made by the United States Department of Agriculture at Arlington, Virginia, in stifling weed growth and preventing the rapid evaporation of the soil moisture. The dark colour of mulch paper attracts solar heat and increases the soil temperature.

A CAR which changes its own gears, silently, efficiently, and without fuss or effort on the part of the driver, will be on view at the Motor Show, which opens at Olympia on October 11th, and a problem which has engaged the best brains in the automobile industry for thirty years—that of devising a gear-box which shall be simple to operate, silent in action, and resistible to wear—has thus been solved. The firm which has effected it is Armstrong-Siddeley Motors, Ltd., Coventry. For five years, the firm has been secretly engaged on the experimental work from which has evolved this method of automatic gear change, and after a successful test of 50,000 miles the new four-speed gear-box is to be placed on the market.

IN commenting on the explosion of a water-tube boiler, in London, which was caused by shortness of water, the Engineer Surveyor-in-Chief, Board of Trade, says:—"Obstruction of the lower end of a boiler water gauge glass is likely to occur when ordinary rubber packing is used, unless care is exercised, in renewing a gauge glass, to see that the lower end of the glass is below the stuffing-box recess. It is essential for the safe working of boilers that those in charge should realise the importance of arranging that water gauges are thoroughly and frequently tested to ensure that all the passages are free from obstruction. The fusible plug, intended to melt when subjected to any temperature much above that of the working steam pressure, withstood that which made the furnace so weak that it could not support the ordinary pressure. Such plugs are useless as a precaution against shortness of water and consequent overheating."

THE history of the international volt since it was defined by the Electrical Congress of Chicago, in 1893, is briefly reviewed in a paper read by Mr. G. W. Vinal at the fifty-fourth general meeting of the American Electro-chemical Society. The present standard for the volt in the United States is a group of Weston normal cells, maintained by the Bureau of Standards at Washington. Seventeen years have elapsed since the value 1·01830 volts at 20 deg. Cent. was established for the Weston normal cell, and it is a matter of importance, therefore, to determine how well the working standards have maintained this value. Results of recent measurements, which are the beginning of an extended investigation, indicate that the standard in America has not changed by more than one or two parts in 100,000. Such data as are available on the value of the volt in several countries indicate differences that emphasise the importance of renewed work on this subject. Some suggestions for the proper care of the unsaturated form of standard cell which is used commercially are given in the paper.

THE King George III. collection of apparatus at King's College, London, states *Electrical Communication*, contains among other treasures the lodestone used by Faraday in his experiments on induced currents. The collection consists primarily of the apparatus presented to King's College in 1841 by Queen Victoria. It was originally brought together by George III. at the Royal Observatory, Kew. The lodestone is elaborately mounted, and of fine workmanship. On one side of the mounting is written in Russian the word, "Siberia," and on the other, the date, 1777. At the front is a coloured representation of two angels with trumpets, presiding over eight hard-working miners. At the back of the magnet is represented the same angels guarding only seven miners. The fate of the missing miner is not recorded. Below the pictures is written in Russian, a statement of the weight of the lodestone, and the weight it is capable of sustaining. There is also a signature, W. W. Petroff, 1803. An old notebook at King's College records the weight and the pull of the stone, but unfortunately the entries are based upon untrustworthy conversions.

Miscellanea.

NEARLY 50 per cent. of the farming area of Sweden is electrified, and, according to a recently published report, the electric energy generated by water power alone amounted to 4·35 billions units in 1927. Recent additions to plants will shortly increase the capacities still further.

A MEETING of the International Scientific Radio Union is being held in Brussels to consider means of accelerating the advancement of practical applications of radio-electrical science. On the initiative of Mr. Robert Goldschmidt, the Belgian Secretary-General of the Union, who contributed 200,000f. (£1140) as a first gift, says *The Times*, it has been decided to establish in Brussels a radio-telegraph experimental centre.

ADDRESSING over two thousand employees of the Tilmanstone Colliery, Mr. Tilden Smith announced a programme involving an expenditure of £2,000,000. Before the end of the year, he said, they would start on the construction of the biggest cement works in the world. In three or four years' time they would see at that colliery an output of 4000 tons of coal per day, a large portion of which would be consumed in its own factories.

THE General Electric Company of America recently transmitted a two-character play, "The Queen's Messenger," the audience hearing the actors and seeing them on a screen 3in. square. Although the actors and audience were in the same building, the signals actually travelled 8 miles, being transmitted from the aerials at Schenectady, 4 miles away. The performance was broadcast on three wave lengths—by television on 279·5 m. and 21·4 m., and by telephony on 31·96 m.

THE Dominion Cabinet on September 18th ratified the lease to a subsidiary of the Winnipeg Electric Company of the power rights of the Winnipeg River at Seven Sisters Falls on a thirty-year basis. It is estimated that the power to be developed will amount to 1,230,000 horse-power, and an expenditure of approximately 8,000,000 dollars (£1,600,000) is involved. Work on the new power source, which is being tapped mainly for the requirements of Winnipeg, will begin immediately.

STATISTICS concerning the progress made with the rural electrification scheme operated by the Chester Corporation electricity department are contained in the report of the proceedings of the Conference on Electricity Supply in Rural Areas. During the four years 1925–28 the number of consumers has increased from 318 to 1188, and the total units sold from 112,084 to 748,512, the average consumption per consumer in that period having nearly doubled, while the average consumption per head of population has increased from 7·3 units to 48·9 units.

THE experimental air mail and passenger service between Liverpool and Belfast was inaugurated last Monday by the flying-boat "Calcutta," which arrived in the Musgrave Channel nearly an hour behind the scheduled time, owing partly to unfavourable conditions encountered on the journey. Passengers and mails were conveyed to the Musgrave Quay by motor boat. The flying boat was visited by an official party, including the Lord Mayor of Belfast, the High Sheriff, the Ministers of Commerce and Finance, and the town clerk, and a flight was made over the city. The "Calcutta" left later for Liverpool with a full complement of mails and passengers.

STATISTICS have been issued by the district manager of Post Office telephones in Belfast, showing that since the beginning of the present year 1100 new subscribers have been connected, while twenty-six additional trunk circuits have been provided. Five new telephone exchanges have been established, viz., at Newtownbutler, Garvagh, Killyleagh, Lisnakea, and Richill. Extensions of exchanges have been completed at fourteen towns, whilst the provision of new exchanges is in hand at Annaghmore, Clogher, Crossmaglen, Fivemiletown, Saintfield, and Sion Mills. Additional public telephone street kiosks have been provided to the number of thirty-nine, and the provision of eighteen more is in hand. Rural call offices are being established at Ballynure and Straid.

A NUMBER of maps have been prepared for the Greater London Town Planning Committee, which is carrying out a survey of an area of some 2000 square miles within 25 miles of Charing Cross. The maps show how Greater London will be served by new roads proposed by the Ministry of Transport; where industrial developments are taking place, or may be expected; and where open spaces exist. The last map is of special importance in view of the possibility that an effort will be made to keep open a green belt round London. The Committee, of which Sir Banister Fletcher is Chairman, is composed of representatives of 126 local authorities, who administer the affairs of a population numbering some 11 millions. The assessable value of this area is £82,000,000. The district to be dealt with is the largest in Europe to be surveyed in one regional plan.

THE Dublin Corporation electricity works is to supply electricity to some thirty-two towns and townships in the Leinster area of the Irish Free State from and after October 1st. This will be done by overhead network erected throughout the province in connection with the Shannon scheme. The linking-up with the Dublin electricity department is only a temporary arrangement until such time as the Shannon scheme is completed. The Electricity Supply Board is now considering the question of charges, and it is stated that probably a fixed minimum charge per week for electricity, based on the valuation of the customers' houses, will be put into operation. The fixed charge will include the repayment of the cost of wiring customers' houses. Over and above such a minimum charge, a charge of 2d. per kWh will be charged to users for electricity supplied. At this rate it is calculated that occupiers of five-roomed houses in the rural towns, where the rateable values are low, will pay about 2s. 6d. per week for the lighting of their houses, and a supply of power sufficient to work a vacuum cleaner and an electric iron. This sum will also cover the cost of wiring. The Supply Board intends to give the arrangement a trial for one year, and if it proves satisfactory, then rates on a corresponding basis will be finally fixed for the full Shannon scheme when it comes into operation next year.

MACHINE TOOLS AT THE OLYMPIA EXHIBITION

(For description see page 334)

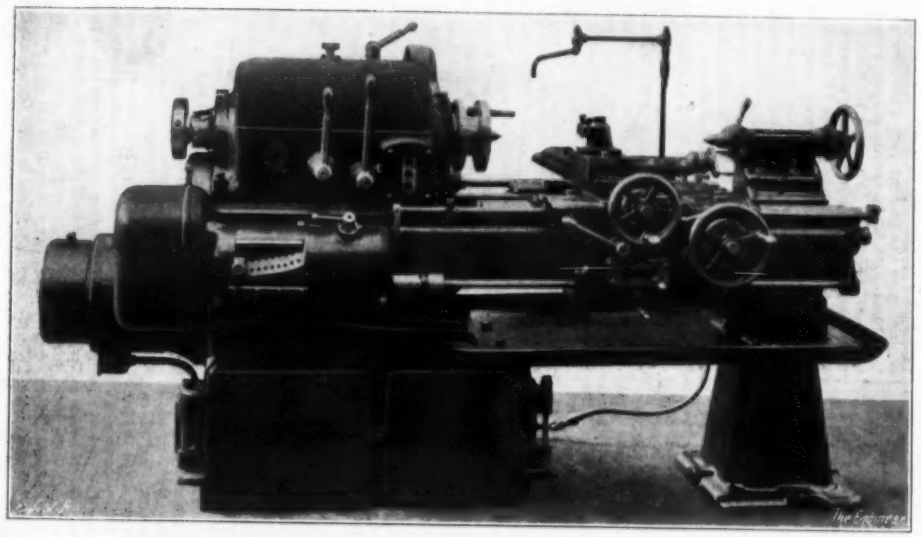


FIG. 88—ELECTRICALLY-DRIVEN TOOL-ROOM LATHE—DEAN, SMITH AND GRACE

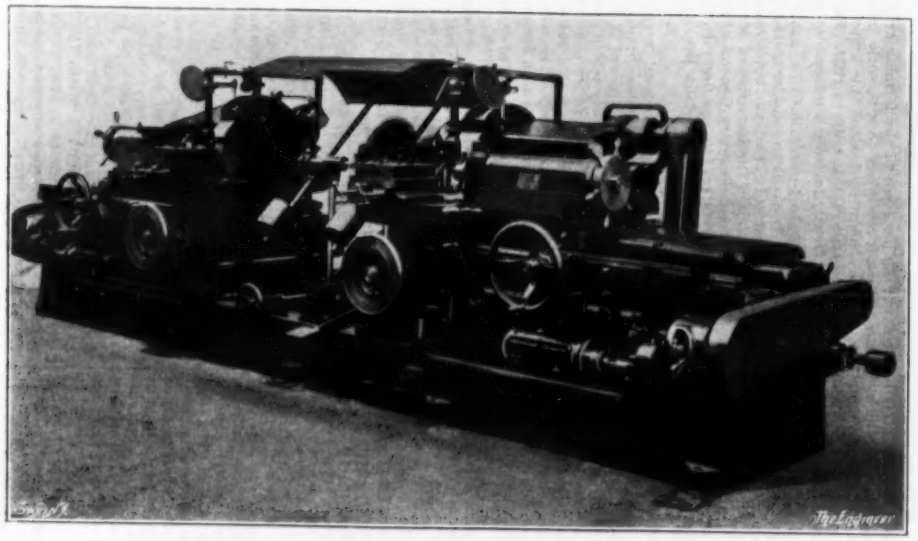


FIG. 89—RAILWAY AXLE JOURNAL GRINDING MACHINE—CHURCHILL

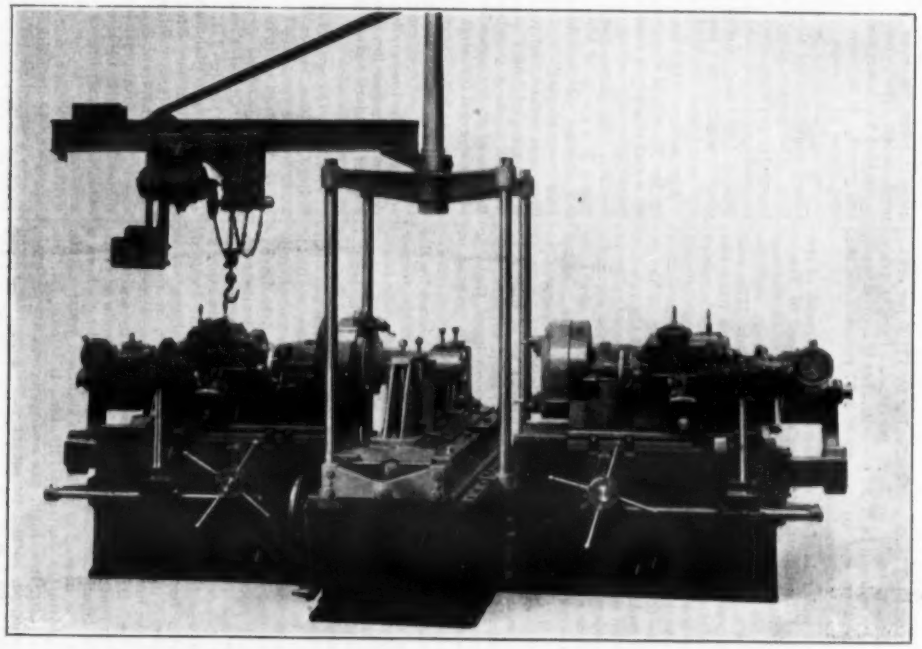


FIG. 90—AXLE-BOX BORING AND FACING MACHINE—KEARNS

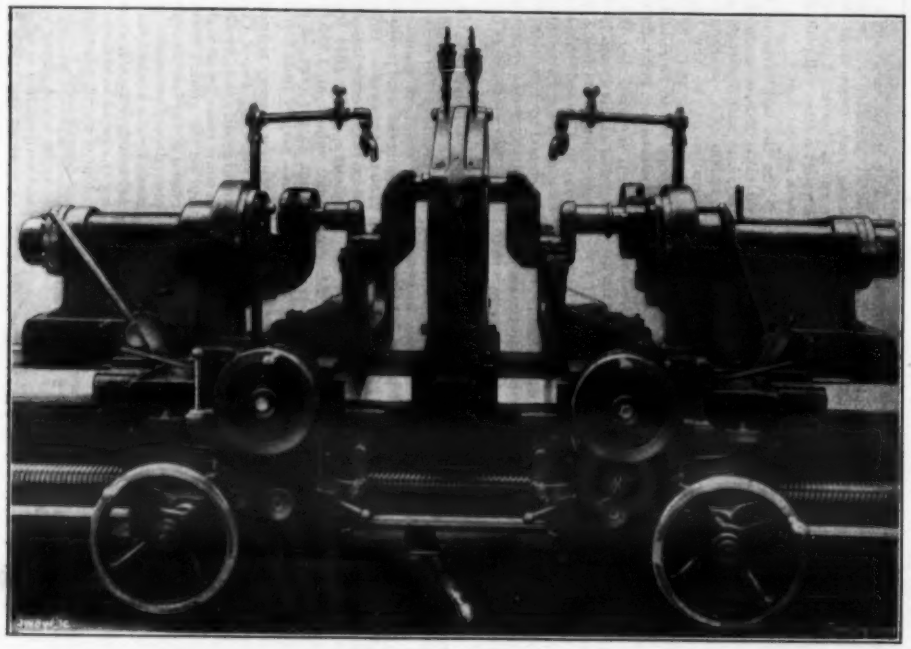


FIG. 91—MOTOR CAR AXLE AND CRANKSHAFT LATHE—CRAVEN

The Engineer

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The Metallurgist.

THE SEPTEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

SEPTEMBER 28, 1928.

Ten Years Ago.

AT the present time articles recalling the fateful events of ten years ago are appearing almost daily in the newspapers. This feature of current journalism has been condemned in some quarters on the ground that it tends to revive sombre memories which are scarcely calculated to promote a spirit of amity among the late belligerent peoples. Yet it is only natural that those who lived through the terrible days of the Great War should be interested in the chronicle of those critical and, as the event proved, decisive phases of which the year 1918 was so prolific. The feelings evoked by such reminiscences are, we are convinced, of a salutary nature. There is not now, nor was there ever in this country, any inclination to gloat over the misfortunes of our enemies. The dominant sentiment is one of profound gratitude to Providence for the nation's deliverance from a great peril. Ten years ago we were still fighting for existence, but there were plain indications that the tide had turned definitely in our favour. Early in September, 1918, if not before, ultimate victory had become, humanly speaking, a foregone conclusion, though none dared to hope that it would be realised so soon. Mighty preparations were in train on land, at sea, and in the air for prosecuting the struggle with unexampled vigour in the following year. A few optimists predicted the collapse of the Central Powers by the spring of 1919, but the consensus of opinion was that the summer or the autumn of that year was the earliest period at which we could hope for victory. And yet, looking back upon the events of July, August, and the first week in September, it seems strange that we should have so sadly underestimated their significance.

Early in July it became evident that the German offensive on the western front had been not merely checked, but decisively repulsed. The enemy's feeble reaction to Foch's brilliant counter-stroke told, or ought to have told, its own tale. In this, her final, furious bid for victory Germany had drawn so heavily upon her dwindling reserves of power, both human and material, that its failure left her virtually bankrupt. That the Allies should still have deemed her capable of maintaining the struggle for yet another year was a genuine tribute to the fortitude and endurance of the German nation. General Ludendorff and the other German war leaders were under no illusion as to the situation, and the tribunal of history may not acquit them of the charge of prolonging a struggle which they already knew to be hopeless. On the other hand, they might plead that resistance to the last seemed to them the only means of obtaining favourable terms of peace. In this they were again at fault, however, for it is certain that a capitulation in August or September, 1918, could have been negotiated on terms no more stringent than those which they were forced to accept in November, and perhaps less so. During the summer and autumn of 1918 the eyes of the world were concentrated on the western front. So far as popular interest was concerned, the naval campaign had faded into the background. Yet it was upon the sea, rather than on land, that the issue was really decided. Eighteen months previously the Germans had launched their intensive submarine campaign. The risks involved in this deliberate flouting of powerful neutral nations, chief among which was the United States, had been weighed and accepted. While the danger of provoking the United States into active hostility was not overlooked, the German war leaders had satisfied themselves that her intervention could not become effective before the U-boats had brought the Allies to their knees. With the wisdom begotten of after-knowledge it is easy to condemn what proved to be a gross miscalculation on their part. The fact remains that the wholesale destruction of Allied and neutral tonnage throughout the year 1917 did place the Allied cause in extreme jeopardy. How critical the situation had become by midsummer was mercifully hidden from the public at large. Ships were being sunk right and left, and the sum of tonnage lost was out of all proportion greater than the replacements. Both belligerents were fighting against time, the Central Powers striving to win victory by paralysing the oversea communications of their enemies before America could throw her weight into the military scale, the Allies fighting to maintain command of the sea, in the broad sense of the term, until America had mobilised her incalculable but latent resources. In the end the Allies won the race but by no considerable margin. Not until the year 1918 was well advanced did the combined output of new tonnage begin to balance losses. But as soon as that happened Germany's defeat became only a question of time. Whenever, nowadays, we feel disposed to cavil at America for demanding a generous share of sea power, let us try to remember that it was mainly in response to our own urgent appeal that she embarked on a huge programme of naval and mercantile construction. It would surely have been too much to expect her to renounce her newly born maritime ambitions as soon as the immediate purpose which had stimulated them had been achieved. The failure of the U-boat campaign as a decisive factor appears to have been recognised in Berlin towards the end of 1917. Millions of tons of shipping had been sunk, yet supplies of food and war material from overseas continued to reach the Allied countries in adequate quantity, while a united and intensive shipbuilding effort in Great Britain and America was beginning, slowly but surely, to make good the deficit in tonnage. Finding herself thwarted on the sea Germany again turned to the possibility of ending the war by a thunderbolt offensive in the West. Thanks to the collapse of Russia, Ludendorff was able to transfer the bulk of his divisions in the East to France and Flanders. By the early spring of 1918 everything was ready for the great gamble, for such it was. Up till then America had despatched comparatively few troops to Europe, deeming it advisable to keep them at home until their initial training was complete. But during the first weeks of the great German offensive it looked as though the war would be over before America's millions had a chance to intervene. Then it was that the British and French Governments jointly appealed to President Wilson for the reinforcement of man power that was so desperately needed. The response was instant and overwhelming. From April onwards American

troops came pouring across the Atlantic in numbers so great as to tax to the utmost the transport facilities available. Enemy submarines presumably did their best to hamper the movement, but their efforts were wholly vain. Not a single troop transport on its way to Europe was sunk by enemy action. Much of the credit for this wonderful achievement belonged to the British Navy, but the American Navy also rendered invaluable aid. Indeed, but for perfect team work by the fighting and mercantile fleets of both countries the prompt conveyance of this huge army across three thousand miles of ocean, in the teeth of the submarine menace, could not have been accomplished. As it was, the timely arrival in France of America's first million turned the scale. Ludendorff found himself definitely outnumbered, and while he had no further reserves on which to draw, fresh American divisions were landing in Europe every week.

In the meantime the German nation had received grim and irrefutable proof of the failure of their submarines. At the beginning of August the British Prime Minister had announced that, up to that date, 150 German U-boats had been destroyed. When the accuracy of this figure was impugned in Germany, the British Admiralty published, on September 6th, 1918, a list of 150 German submarine commanders whose boats had been sunk. To this there was, of course, no answer. The list in question was one of the most dramatic documents of the war, and its moral effect in Germany appears to have been profound. All this time the military position from the German point of view was going from bad to worse. By October her armies were retreating on almost every sector of the front, and in the same month serious disaffection made itself manifest in the German navy. Austria, Bulgaria, and Turkey were each and all feverishly seeking an avenue to separate peace, Austria's spirit having been completely broken by the brilliant Italian victory at Vittoria Veneto. The end was therefore in sight. How it came about is still fresh in the memory. Apart from the righteousness of their cause, the Allies may be said to have won the war primarily because they were able to maintain command of the seas, and all the world knows by what agency that command was chiefly upheld. Had our maritime communications been severed, or even seriously interrupted, nothing could have saved us from defeat. That is, perhaps, the outstanding lesson suggested by these reminiscences of ten years ago. Every honest effort to establish peace on a permanent basis will receive the wholehearted support of Great Britain. Many people feel, however, that the cause of peace would be prejudiced rather than promoted by a drastic reduction in the strength of the British Navy, which has proved itself, not once, but many times, the surest guardian of liberty and civilisation.

The Electrically Propelled Ship.

WHEN, at some future time, the history of British marine engineering progress comes to be recorded, the present year will be singled out as marking the beginning of practical interest in the electrically propelled ship, both on the part of the shipowner and the shipbuilder. Within the last few months the Clyde has played a leading part in this now well-defined trend of development. At the end of August, the oil tanker "Brunswick," of which a full description will be found in our issues of September 7th and 14th, was delivered to her American owners by Scott's, of Greenock. This Diesel-electric propelled ship bears the distinction of being the largest of her type in the world. Further up the river at Scotstoun, Yarrow's are completing a smaller oil-electric propelled vessel for South American owners, while on Saturday, September 15th, the new turbo-electric P. and O. liner "Viceroy of India," safely took the water at Stephen's Linthouse yard. Now that a beginning has once been made, it seems to be not unlikely that more ships will follow, and that the field of electric propulsion will be extended from mercantile to naval vessels, to coastal craft, and to harbour tugs and dredgers, for which types of vessel it offers considerable advantages. It is difficult to assign any one reason for the comparatively long delay on the part of British shipowners and marine engineers, in taking up and carrying through electrical propulsion schemes. In the past, perhaps, technical and industrial conditions were not favourable. Now that the manufacture of the slow-speed marine engine has given place to a large extent to the high-speed turbine, coupled to the propeller through single or double reduction gearing and running at speeds very close to those adopted for economical land turbines, with high-pressure and high-temperature steam raised in oil-fired water-tube boilers, it is possible for the engineer to put forward standardised electrical plant with high-speed turbines, which, as regards space, weight, and capital cost, presents a scheme of propulsion comparable with the direct drive. With regard to the oil engine, there has been marked progress in recent years in the production of high-speed oil engines for land power purposes and for auxiliary service afloat, and using such plant it is possible to make an equally attractive electric propulsion scheme. We have good authority for stating that in several recent tenders which called for the alternatives of direct-driven and electric-driven motor ships, the price of the electrically propelled vessel was no more, and in some cases actually less, than that of the direct-driven ship.

In a paper which was presented by Mr. A. C. Hardy at a special meeting of the Institute of Marine Engineers, held at Olympia on Friday, September 14th, the author dealt with the question of electricity aboard ship from the point of view of the shipowner, keeping main propulsion in view. He pointed out that owing to the use of electrically operated deck machinery and engine-room auxiliaries, the auxiliary loads in the modern ship are now increasing very rapidly. In the case of some modern motor passenger liners, notably those which are propelled by double-acting four-cycle engines, the engine-room for the auxiliary generator sets occupies more tank-top space than is taken by the main propelling engines themselves. Instances are quoted by Mr. Hardy of recently designed ships in which the proportion of auxiliary machinery to main propelling machinery varies from ten to twenty-six per cent. With an electrically propelled vessel it is certainly possible to make the main generating units large enough to deal with all auxiliary requirements. In the "Brunswick" the total output of the auxiliary units when running at sea is only one and a-quarter per cent. of the output of the main propelling machinery. In a tanker, however, conditions are different from those of the large passenger liner with its heavy "hotel" load, and in the new P. and O. liner the power of the auxiliary generator sets is about ten per cent. of that of the main propelling motors. The arrangement of the auxiliary plant will, however, in an all-electric ship always depend to some extent on whether direct or alternating current is employed for the main propelling motors. Besides introducing greater compactness and unification of the main and auxiliary plant, electric propulsion confers some benefits which to the shipowner are so important that they would seem to warrant him in overlooking the main transmission losses, which may be fairly assessed at from 12 to 15 per cent. The extreme flexibility of the electric drive is a most valuable asset for tankers, fruit, wool, and meat-carrying ships and other craft in which different speeds on the outward and return voyages are desirable. This factor of flexibility is also of great importance for mail-carrying steamers, and it has an important bearing upon the design of a liner, which part of the year operates in the normal transport service, and at other times may be engaged in a leisurely world cruise. A ship which will operate with the utmost economy under these widely different conditions of working, as the electrically driven ship will undoubtedly do, is very valuable to its owner. It is also possible that electric propulsion will bring with it the direct control of the propelling machinery from the bridge. There is no doubt that vibration is inclined to be less on an electrically propelled vessel than with either geared turbines or oil engines, and there is, too, a definite gain in heavy weather in having a propeller which turns at a constant speed, no matter what its immersion conditions are. Hence, racing is no longer to be feared, and a higher average speed can be maintained in rough weather than is possible with a direct or geared drive.

Some of the above-mentioned points have quite recently been the subject of careful study by British marine engineers, who have made voyages on the liner "California," which is now operating on the New York–San Francisco run. Her owners, the International Mercantile Marine Company, are so satisfied with her performance that two sister liners, the "Virginian" and the "New York," have been laid down. The performance figures of the "California" compare, we are informed, very closely with those of the very economical "Orama" class of liners of the Orient Line to Australia. They are inferior, however, in the matter of fuel consumption to the performance of the Fairfield-built motor liner "Aorangi," which is also operating on the Pacific run. The recent performance of the new "Duchess" class of Canadian Pacific liners has, however, demonstrated that with high-pressure geared turbines and water-tube boilers, a fuel figure can be obtained which is very close to that given by the oil engine-driven ship. We believe that the guaranteed consumptions for the new P. and O. electrically propelled liner are such as will also show this to be true for that vessel. There is no doubt that electrical propulsion is a subject which deserves the closest study by shipowners, shipbuilders, and marine engineers, and that any demands which may be made on our electrical, turbine, oil engine, or marine boiler-making industries will be met up to the very large powers which are now required for the fastest Atlantic liners.

The Iron and Steel Institute in Spain.

No. I.

ON Friday last, September 21st, a large party of members of the Iron and Steel Institute left Victoria by the morning train for Bilbao, where the Autumn Meeting has been held during the present week. The first paper which was read on Tuesday last was written by Mr. Jose Balzola, and gives an excellent description of the iron mines and mining property in Viscaya. It is a long paper, and whilst, unfortunately, we are unable to spare the space to print it in full, we reprint large portions of it on pages 355 and 356.

The local reception committees had made excellent arrangements for the instruction and amusement of the visitors, to which we shall be able to make further reference in a later issue. To-day we give brief descriptions of some of the works visited.

THE SPANISH WORKS OF BABCOCK AND WILCOX, LTD.

The extensive works of the "Sociedad Española de Construcciones Babcock and Wilcox," situated about 5 kiloms. from Bilbao, manufacture Babcock and Wilcox boilers, solid drawn steel tubes, locomotives, all kinds of metal constructional work, boiler plant, and castings in iron and brass.

General Description.—In order to avoid danger of the buildings being flooded, their foundations had to be laid in ground made up to well above high water level in the tidal flats on which the works are built, and which are but 3 m. above mean low tide. The buildings, consisting of fifteen bays, are mostly constructed with reinforced concrete walls, carrying crane runways and supporting steel truss roofs covered with uralite. In view of the difficult nature of the ground, the footings are specially large, so as to give a ground loading of only 0·4 kilos. per square centimetre.

The fifteen bays composing the factory are divided into three groups—Fig. 1—viz., the pattern shop, placed by itself; a group of ten bays forming the general workshops and measuring 100 m. by 20·9 m.; and a third group of four shops composing the steel tube works. All the buildings are served by railway sidings, so that the handling of materials is reduced to simple operations performed by a Maffei locomotive and two 5-ton cranes.

The works are electrically driven, individual drive being employed in most cases, with group drive in a few special instances. Electrical energy is received at 3000 volts, three phase, and transformed down to 220 volts, at which pressure all the motors, cranes and workshop lighting are supplied, and to 110 volts for the lighting of the offices and outbuildings. There are two sub-stations, one for the main works and the other for the tube works. The first contains three 400-kW transformers of the oil-cooled type, two 250-kW 3000/220-volt motor generators supplying continuous current for certain motors, and also two 7·5-kW lighting transformers. The other sub-station contains two similar transformers, and both are equipped with the necessary high and low-tension switchgear, including that controlling the four main motors in the tube works, which operate direct off the 3000-volt supply. The total power which can be supplied to the factory thus amounts to 1715 kW in the first sub-station and 800 kW in the second, plus 895 kW for the four motors operating direct from the line.

Hydraulic power, compressed air and steam are laid on as required to the various works. The steam-raising plant consists of two Babcock boilers, each having 170 square metres of heating surface, and equipped with automatic stokers, superheaters, feed-water heaters, Weir feed pumps, water-purifying plant, and CO_2 recorders. These boilers supply steam to the hammers in the forge and tube departments, and to the hydraulic power station. The draught is provided by a self-supporting steel chimney built by the company, which is 32·46 m. high and

1·755 m. in diameter, and suffices also for the requirements of the forge and punch shops.

The hydraulic power station, which supplies power to the riveting machines and to the test beds for boilers and tubes, contains a Simpson triple-expansion, double-acting pump, connected to a hydraulic accumulator with a working pressure of 105 kilos. per square centimetre.

The compressed air plant consists of three air compressors by Fullerton, Hodgart, and Barclay, with a capacity of 8500 litres per minute at 7·75 kilos. per square centimetre, each driven by a 65 H.P. motor. The air is delivered to two regulating reservoirs, from which it is conducted through more than 600 m. of pipes, with frequent flexible hose connections, to the hammers, caulking tools, &c., which it supplies.

There is a full complement of auxiliary plant, such as gas-generating plant for welding and cutting machines, electric welding plant, tool forging and hardening plant, &c. &c.

Tube Works.—Turning now to the works themselves, we will begin with the tube works, which are undoubtedly the most interesting part of the plant. These consist of four buildings, each 95 m. by 20 m., of which two are served by 5-ton and two by 10-ton overhead travelling cranes, all of which were built by the parent company, Babcock and Wilcox, Ltd., of London, and are of the three-motor type. The tube works contain altogether forty-five motors, ranging in size up to 450 horse-power.

The manufacturing process consists in essence of piercing a hole in a circular piece of steel, previously made red hot, in special perforating machines, and then rolling the metal between rolls of special section. The tube after rolling goes to the draw benches, where it can be drawn either hot or cold. The mills can turn out tubes of an external diameter of 51 mm. up to 102 mm. The main rolls occupy the second bay, reckoning from north to south, and the same aisle, which is served by one of the 10-ton cranes, contains machines for centering the steel rounds, furnaces for heating the mouths of the tubes, machines for expanding the mouths of the tubes, so that they can be gripped in the draw benches, and various other machines, such as testing and cutting machines, air compressor, tube-straightening machines, &c. One of the hot draw benches with its corresponding furnaces is also situated in this bay.

The small tube-perforating and rolling mill occupies the southernmost bay, and turns out tubes up to 51 mm. external diameter. Here there are also two hot draw benches. In Fig. 2, which shows this bay, the furnaces for heating the raw material can be seen at the far end; on the right, in the background, is the perforating machine; in the left background is seen the rolling mill; while in the front and on either side are the two hot draw benches and their appurtenant furnaces. This bay, served by a 5-ton crane, also contains a number of auxiliary machines, such as those for reaming, expanding and cutting tubes, hot saws, &c.

The three double cold draw benches occupy the northernmost bay of the group. In these the cold tube, after being rolled and expanded, is passed through the draw plate or die. The necessary ancillary plant is also installed for tube annealing, cutting, screwing and galvanising.

The third bay is devoted entirely to the making and renewal of parts for the perforating, rolling and drawing plant, and contains four steam hammers, milling machines for making the rolls for the rolling mills, blacksmiths' shop, &c., and a tube-testing plant.

The furnaces are heated by gas produced in four gas generators, housed in a separate building, from which the gas is taken to the furnaces through a network of pipes, provided with all the necessary valves, explosion doors, &c. This installation is served by seven steel chimneys of various heights and diameters.

General Workshops.—The general shops comprise eleven bays, as follows:—Pattern shop and store; ironfoundry—Fig. 3—brassfoundry; metal construction assembly and erection shops; locomotive fitting and machine shops; tool-room; brass and coppersmiths' shops; locomotive erection shop—Fig. 4—boiler fitting and erection shop; and, finally, forge and punch shop.

Pattern Shop and Foundry.—The pattern shop comprises wood storage and drying accommodation, saw mill, pattern shop proper, and pattern store. The saw mill and pattern shop contain five saws, viz., a vertical machine with a 9 m. carriage, a band saw, two circular saws, and a 600 mm. pendulum saw. In addition, the pattern shop is fully equipped with planing machines, lathes, drilling machines, guillotines, morticing and smoothing machines, &c.

The foundry equipment is very complete, and includes, first, a group of preparation machinery for dealing with sand and coal, and consisting of three mills, two mixers, six sand screens and a coal crusher. Of these, the sand screens are operated by compressed air and the mills and mixer by a 25 H.P. motor through shafting. Another group of machines prepares moulds and cores, and includes three pneumatic and three hydraulic moulding machines, together with core-drying ovens, &c. The crane arrangements include two travelling cranes of 20 m. span, together with five 2-ton hydraulic jib cranes, &c.

The foundry plant itself consists of two cupola furnaces with an hourly productive capacity of 5 and 10 tons respectively. They are provided with forehearths and are charged by means of a hydraulic hoist of 2500 kilos. capacity, which raises the coal, pig iron and scrap from the service runway extending along the outside wall of the shop to the charging platform. The air is blown in by two fans with a capacity of 198,240 litres per minute, at a pressure of 838 mm. water column, each of which is driven by a 65 H.P. motor.

The castings are fettled partly by hand and in the case of large examples with the help of pneumatic tools; smaller varieties are dealt with in rotating drums, of which there are five, or by means of emery wheels, from which the dust is carried away by suction. These machines are group driven by a 40 H.P. motor.

Structural Steel Shops.—A very interesting branch of the factory is the construction of electric cranes, conveyors and metal construction work of all kinds. Two entire bays are devoted to this work, each being served by a 10-ton crane.

In these works the large space required for marking out is situated on the floor above the tool-room. Amongst the machines provided for the cutting of plates and sections are a circular saw, a band saw, a plate shears, an oxy-acetylene plant, and a planing machine for planing the edges of plates, which has a carriage travel of 5 m. and is driven by a 10 H.P. motor.

A battery of six radial drilling machines is installed, each of which has a radius of 2·438 m., and is independently driven by a 7·5 H.P. motor, and can be moved into position along rails provided for the purpose. There is a further horizontal drilling machine driven by a 10 H.P. motor. A punching machine makes holes up to 25 mm. diameter in 20 mm. plate, and a second machine punches similar holes in 22 mm. plate.

In the plate-bending and straightening department, there is a "Craig" machine for plates up to 12 mm. in thickness, and a "Bertrand" machine for 15 mm. plates, and also machines for bending sections.

All structures are fully erected during construction, and for riveting purposes there are provided, besides pneumatic hammers, a battery of hydraulic riveters of the cantilever type operated from platforms running on rails so disposed as to make it easy to reach the work. Caulking is done entirely by pneu-

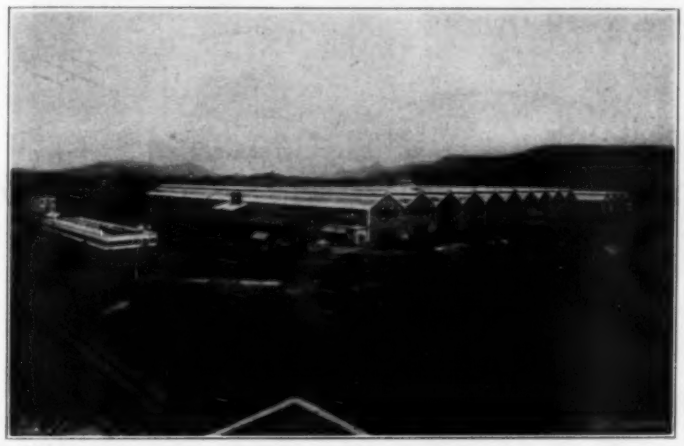


FIG. 1—WORKS OF THE SOCIEDAD ESPANOLA BABCOCK AND WILCOX

FIG. 2—VIEW IN SMALL TUBE SHOP

FIG. 3—IRON FOUNDRY

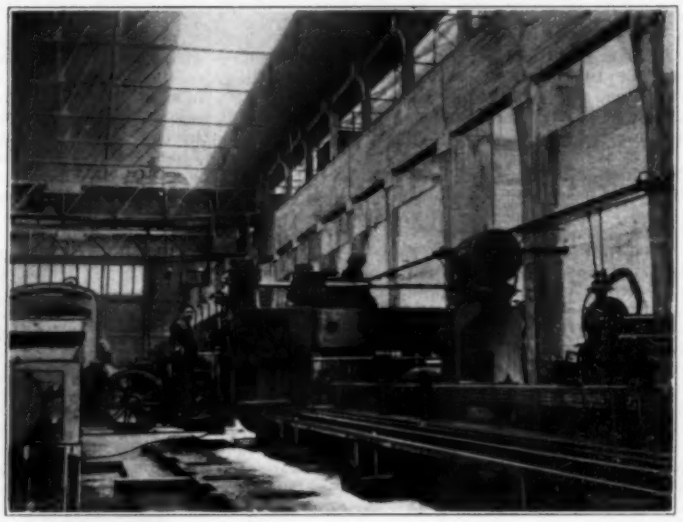


FIG. 4—LOCOMOTIVE ERECTION SHOP

matic tools. In this shop there is a range of fitters' benches, rivet heaters, and a pneumatic hammer, &c. &c., and, finally, for the erection of structures too big to be set up in the shop, there is a 4-ton jib crane with a lift of 23 m. attached to the outside wall of the building.

As locomotive tenders are also constructed in these shops, the necessary tracks and erection pits are provided for this purpose.

Fitting Shop.—The fitting shop occupies two bays, each served by an overhead crane of 20 m. span and 10 tons lift. In this shop there are altogether forty

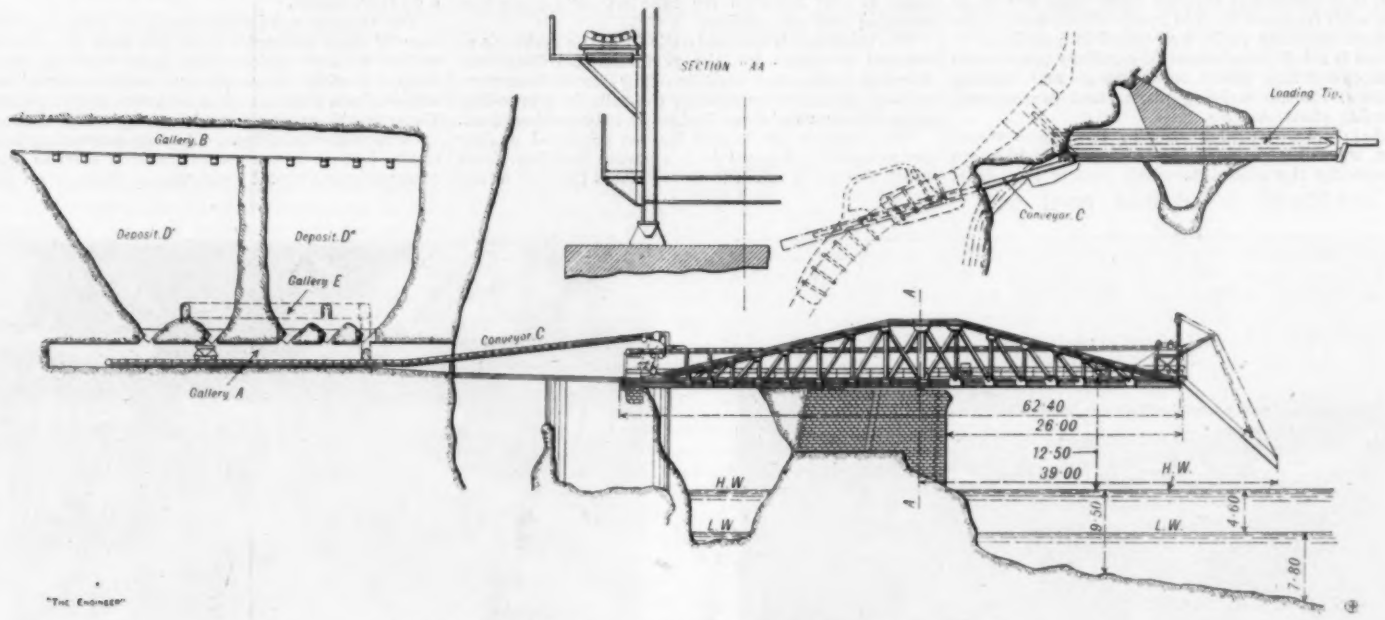


FIG. 5—DEPOSIT CHAMBERS AND LOADING TIP, COMPANIE DE SETARES

motors, totalling 700 horse-power, of which only eight operate with other than individual drive.

Boiler Shop.—The boiler shop and the fitting shop supply the locomotive erecting shop with the component parts of the finished product. The work of the latter is greatly facilitated by two 40-ton overhead cranes, with a span of 20 m. and an auxiliary hoist of 10 tons. These cranes have travelling, traversing, and hoisting motors of 20 H.P., 8 H.P., and 15–20 H.P. respectively, and a maximum height of crane hook of 9·5 m.

There are three erection and inspection pits, each 75 m. long, of which the central one has both broad-gauge and metre tracks, and all of which are fully equipped with connections for compressed air and electric light and power.

This shop is equipped with various portable tools, such as cylinder boring tools, milling machines, drills, electric and pneumatic grinding tools, and a very powerful machine for milling the members of locomotive frames—depicted in Fig. 4—which has a bed measuring 15 m. by 2 m.; a tool carrier, movable either along or across the bed, for milling vertical surfaces, and driven by a 25 H.P. motor; and two radial drills with a radius of 2896 mm., and provided with separate working and traversing motors of 7·5 H.P. and 4 H.P. respectively, which take current from trolley wires. This machine finishes at one time and with only one setting-up operation five locomotive frame members with an individual thickness of 32 mm.

A 350-ton hydraulic press is available for operations such as pressing cranks on shafts, &c.

The installation for cutting plates and sections includes many powerful tools, and the riveting equipment is notably complete, including both pneumatic and hydraulic machines.

The total power of the motors employed in the boiler erection and fitting shops is 455 horse-power.

The works are well situated as regards transport and communications, since, not only do the works sidings connect directly with the broad gauge Triano railway system and its connections with other important lines reaching every point in the Peninsula, but the plant is situated on the Galindo estuary, and is thus ensured easy access by water to the Port of Bilbao.

COMPANIA MINERA DE SETARES.

The Setares company was founded in the year 1886 by Messers Sota and Aznar, under whose management it has been developed. The prospecting of its mines began under great difficulties, as its loading tip was destroyed by a storm when the concrete foundations were about to be laid; but the energy and efforts of the managers have succeeded in bringing the company to the prosperous situation in which it finds itself to-day. The Compañía de Setares has been virtually the origin of the companies under the same management; that is to say, the Compañía Naviera Sota and Aznar, with its thirty-nine steamers, making a total of 254,290 tons capacity; the Compañía Minera de Sierra Alhamilla (Almería), from whose mines had been extracted 3,544,255 tons of iron ore up to the end of the year 1927; the Compañía Euskalduna de Construcción y Reparacion de Buques, which has built seventy-nine vessels of 143,626 tons, 113 locomotives (55 to 110 tons), and 1108 railway wagons and passenger cars; the Compañía de Remolcadores Ibaizabal, with eleven tug boats, and one under construction; the Compañía Minera de Sierra Menera, with its mines at Ojos Negros (Guadalajara and Teruel), which have produced 9,746,000 tons in twenty years, of which 957,961 tons were raised in 1912 and 987,562 tons in 1913, with its railway of 204 kiloms. to the port of Sagunto; and finally, the Compañía Siderúrgica del Mediterraneo, with its blast-furnaces, steel furnaces and rolling plant in Sagunto, which represent an investment of 115 millions of pesetas.

The Compañía Minera de Setares works two mining districts—that of Setares similar to that of Dicido, the deposits of which originate from a transformation of the Cenomanian limestone into iron oxide, worked mainly in open cuts, and that of Saltacaballo, formed by six fissure veins of carbonate and oxide of iron, which cut the stratification of the barremian limestone which may be considered as the continuation of the deposits in Vizcaya and their introduction into the sea, and which are worked underground at a lower level than that of the sea, but parallel with the shore.

The total production of the mines up to December 31st, 1927, was 5,929,589 tons.

The transport of the Setares ores is made by means of inclined planes to the mill, where 40 per cent. of the total production of the mine is obtained by the washing of the argillaceous earth with ore fragments (Chirteras). This ore, together with the lumpy ore which comes direct from the mine, is conveyed by a railway, 2 kiloms. long, of which 961 m. are through a tunnel, to the wharf deposits.

The transport of the ore from the Saltacaballo district is done by ascending inclined planes, operated by electric power, to the level of the deposits. These deposits, with a total capacity of 37,000 tons, are in the open air and underground. The latter, designed and built by the director-engineer of the company, Mr. Eduardo de Aburto, are hollowed out of the barremian, psamite, and limestone. They have a capacity of 7800 tons and are divided into three compartments by partitions of the same rock. The railway wagons arrive on a track laid upon I beams, supported by reinforced concrete joists, and discharge the ore into the deposits. At the bottom of these huge chambers there are conveyor belts, 914 mm. wide, placed at a distance of 22 m. under the railway line, and the ore is discharged upon them by means of discharging cars. These conveyors in their turn load a belt installed along the loading tip. The loading tip is of the cantilever type. The length of the projecting end is 26 m., and the total length 62·40 m.—see Figs. 5 and 6.

The open-air deposits discharge their ore into wagons that run on the wharf, placed at 17·10 m. above the equinoctial low tide, and tip their contents into a chute extended to the vessel which is to be loaded. The conveyor belt placed at a height of 3 m. above the railway track, also tips its contents into the chute. This belt is fitted with a scale

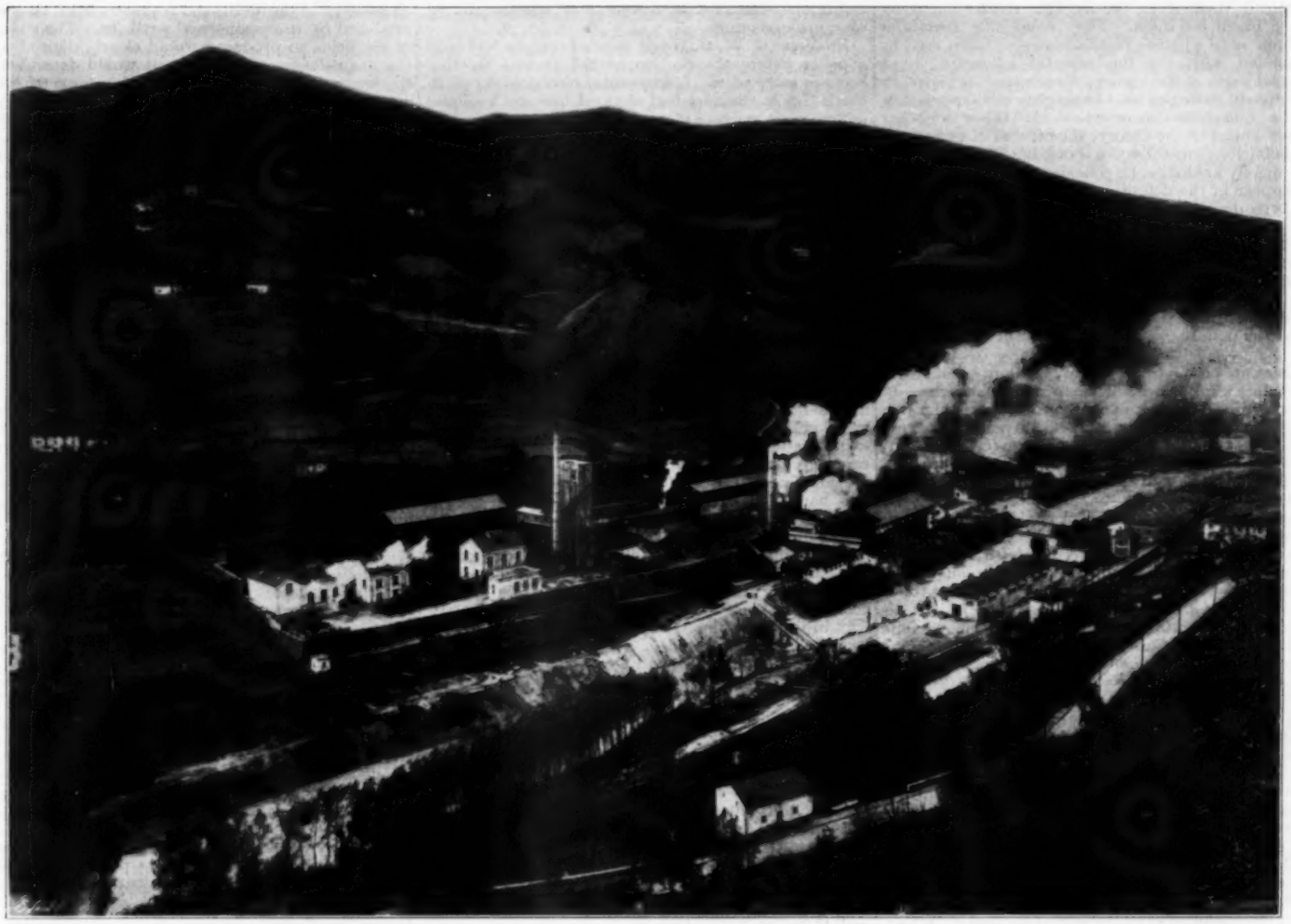
FIG. 6—LOADING TIP, COMPANIA DE SETARES

which controls the weight transported by it. All the conveyor belts are driven by a single electric motor.

Through this tip are also shipped the oxides from the mine "Sorpresa," which conveys them on an aerial ropeway, 9½ kiloms. long, to a deposit situated on the Setares railway, and those from the mine "Josefa," which effects the transport of iron carbonate on a wire rope 3 kiloms. long to another deposit situated also on the same railway.

A 4500-ton boat can normally be loaded in ten hours, it being possible to load during 300 days in the year, the mooring place being protected from the north-west winds which are the prevailing winds on the coast.

THE WORKS OF THE SOCIEDAD ANONIMA ECHEVARRIA, BILBAO



The total tonnage shipped through the Saltacaballo loading tip was 7,301,558 tons up to December 31st, 1927.

THE ECHEVARRIA COMPANY.

Half a century ago, in 1878, the foundations were laid of the industrial concern known to-day as the Sociedad Anónima "Echevarria." The beginning of operations was the installation in the district of Recalde, near Bilbao, of a factory for the rolling of tin-plate used in the manufacture of jam tins. The next step was the manufacture of galvanised pails and frying-pans. In 1887 the works grew in importance with the installation of a nail factory, equipped with patented machinery of the company's own invention. These successive extensions compelled the new industry ever more urgently to seek efficient means of becoming self-contained, and, with this end in view, a Siemens-Martin furnace was put down for the production of steel, and the first rolling mills in Spain to be electrically driven were set to work. Workshops were erected for the reconditioning and repair of old machinery and the manufacture of new. Later, the construction of all kinds of engineers' ironwork was embarked upon, and extensive workshops were erected for this purpose. The plant further comprises all the usual ancillary departments, such as foundry, smithy, carpenters' shop, ceramic department, hydro-electric works and power plant, warehouses, storage grounds, testing facilities, &c. By such steps the original workshop at Recalde grew into a great industrial concern.

But, great as had been the activities of the company up to that time, it continued to grow, and in 1901 acquired the wire works of Santa Agueda and Castrejana, which it has since overhauled and brought thoroughly up to date.

These three plants—Recalde, Santa Agueda, and Castrejana—together constituted an industrial unit of first-rate importance, which acquired even greater prominence by the execution of a bold plan of introducing still further manufacturing operations. The Sociedad Anónima Echevarria decided to introduce into Spain the production of special steels, and devoted all its efforts to this ambitious plan, thereby taking its place in the front rank of national industrial concerns. Coke ovens with by-product recovery plant were installed at the Santa Agueda works, together with a blast-furnace, in which, using coke and specially selected iron ore, a pig iron is produced which has a very low phosphorus and sulphur content. Electrical energy is produced at these works by a Diesel engine set, and is used in the electro-metallurgical plant. At Recalde electrical furnaces were installed for the production of special alloy steels, such as chrome, nickel, tungsten and vanadium steels, also high-speed and extra high-speed tool steels and rustless steel. For heating these steels, electric reheating and annealing furnaces were put in, together with a battery of steam hammers, and rolling mills, specially designed for rolling these materials. Finally, the plant is completed by chemical, mechanical, and metallographical laboratories, which are veritable models of their kind, and in which the steels produced are subjected to rigorous tests, assays and analysis.

The realisation of the entire manufacturing process, from raw materials to finished product, by scrupulous, rational, and methodical means, has been the reason for the success of this company's steels, known in the market as Heva brand.

The Spanish Government, keenly interested in the establishment in Spain of a steel industry of this nature, has subjected its products to a severe fiscal control. The most eminent Spanish scientists have visited the Echevarria factories, inspecting its manufacturing facilities, and submitting both these and its *personnel* to tests designed to prove the perfection of the one and the facultative skill of the other. These scrupulous investigations have induced such important bodies as the Permanent Commission for the Testing of Materials of the National Arsenal Laboratory and others to recognise and proclaim the ability of the S.A. Echevarria to produce steels of every kind. The principal builders of motor car and aeroplane engines, and other constructors, whose requirements are equally exacting, are users of the S.A. Echevarria's Heva brand steels.

The Sociedad Anónima Echevarria, by dint of its perseverance and the skill of its technical staff, and at great financial sacrifice has given a new impetus to the metallurgical industry of Spain, and it claims that it has placed that country on a level with others in the manufacture of special steels.

"THE Story of Rail Steel," an educational film in three reels, produced by the Rail Steel Bar Association of America, has been released for distribution to architects, engineers, contractors, building officials, engineering students, and all those interested in the relation of the steel industry to reinforced concrete construction. The picture shows the manufacture of concrete reinforcement bars, portraying each consecutive operation, from the refining of pig iron to the final use of the bars in the reinforced concrete construction. The supplying of the film is one of the educational activities of the Rail Steel Bar Association.

The British Association.

(*Concluded from page 316*)

ELECTRICAL TERMS AND DEFINITIONS.

A report was to have been presented by the Committee which was formed in 1926—following the publication by the British Engineering Standards Association of a glossary of terms used in electrical engineering—to consider, and, if possible, arrive at some agreement on definitions of electrical terms. The Committee, however, had not prepared a report, owing to acute differences of opinion which had arisen, and the purpose of a discussion which was held on Wednesday, September 12th, was to give an opportunity for further expressions of views. Professor J. D. Cormack presided.

Sir J. B. Henderson, Chairman of the Committee, who opened the discussion, apologised for the fact that no report was presented. The Committee was inaugurated at the Oxford meeting of the Association in 1926, following the publication of the B.E.S.A. Glossary. Some of the members had objected to certain of the definitions in that Glossary. There had been two meetings during the past year, at which attempts were made to come to some agreement, but without success.

Sir James went on to explain one or two of the fundamental differences which should be discussed. Difficulties arose partly, he believed, from want of appreciation of the state of the art when the definitions were first propounded. The masters of physical science of forty or fifty years ago were not accustomed to writing their equations in the modern form, so that the dimensions of both sides of an equation were in agreement. A good deal of confusion had arisen because of that fact.

A fundamental problem had arisen in the discussion relating to difference of potential. It had become so customary to measure differences of potential by means of voltmeters and other instruments that one was apt to forget that a voltmeter or other instrument did not measure potential differences under all circumstances, and therefore it was difficult to define differences of potential by means of the measurements by instruments. In fact, we must clearly distinguish between the definition of a quantity and its measurement. In many branches of physics the measurement of the quantity could not be obtained directly from the definition. We had to adopt round-about methods of measuring what was easily defined physically.

Professor C. L. Fortescue, in a written communica-

tion, said that the discussions at the meetings of the Committee had revealed certain divergences of opinion with regard to the form that some of the definitions should take. These differences did not relate to the quantities themselves or to the electro-magnetic theory based on them. They arose only from the question as to whether certain concepts often used in connection with the fundamental quantities were essential parts of the theory, or whether the concepts were merely analogies used to simplify the explanation of the quantities themselves. If these concepts were essential to the theory, then it was obvious that the definitions must involve them, but if the concepts were merely analogies, he considered that they should not appear in the definitions. His own views, which had been developing gradually for many years, were that these concepts were, in fact, merely analogies, and were not essential parts of the theory. Consequently, he had strenuously opposed any forms of wording of the definitions which by direct statement or by implication appeared to him to make them dependent upon these analogies. The difficulties had arisen mainly over the definitions of displacement and magnetic flux. The definitions of the flux densities, or permittivity and permeability and of the unit tubes were also involved to a lesser degree. It was very usual to look upon the forces and fluxes as being analogous to stress and strain and to regard the fluxes as being effects caused by the forces. Many writers even regarded them as being of different physical natures and related to one another by quantities—the permittivity and permeability respectively—which were of unknown physical dimensions. He could not accept these views as being more than illuminating analogies. A very careful reading of Maxwell and of his more conspicuously successful interpreters strengthened him in this attitude. They made free use of the analogy, but it had no place in the essential mathematics or in their definitions of the quantities.

Another very commonly held view was that the fluxes in material matter were in some way different from those in the ideal perfect vacuum. It was not clear what the difference was or why there should be any difference, and if the modern views of the constitution of atoms and electrons were even approximately correct the forces and fluxes must always be effects related to the ether of space, whether the disturbance constituting material matter were present or not. As he understood the matter, the situation was as follows:—There were two states, viz., the electric field and the magnetic field. The so-called "forces" were the measures of the intensity of these fields, as given by the mechanical forces per unit acting on indefinitely small charges placed at the points in question. A unit tube of force was one having a definite value for the surface integral of the field intensity over its cross-section normal to the direction of the field. Whether this was unity or 4π was a matter of convention. The aggregate of the number of these unit tubes under consideration was the flux, and the number of these tubes per unit area was the flux density, which, by definition, must be the same as the intensity of the field. The definitions of potential followed in the usual way. In an electrical condenser with a perfect vacuum between the plates and with a certain charge there would be a certain distribution of field, and the line integral of the field strength gave the potential difference between the plates. With a solid insulating medium a complex field existed, with the result that for the same condenser and the same charge the line integral of the field strength was reduced inversely to the permittivity of the material. Whether in a perfect vacuum or in a material medium, a rate of change of electric flux density was equivalent to a current. When a magnetic material was placed in a magnetic field there were two components of the resulting field; one due to the magnetic source external to the magnetic material, and one attributable to some action of the magnetic material itself under the influence of this applied field. The resultant of these two fields was the actual field giving rise to external effects by means of which it could be measured, but was not the actual field existing at every point—no means were known of measuring this.

Many objections had been raised to these views, but they had all been easily answered, for the simple reason that the framework he had outlined stood on the basic experimental facts, with the single exception of Maxwell's supposition that a rate of change of displacement was magnetically equivalent to a current. The whole of the usual electric and magnetic theory followed directly, the only innovation relating to the introduction of the permittivity in the denominator of the expression—

$$E = \frac{4\pi D}{\varepsilon}$$

When he used this relationship he always introduced the reservation that the E referred to was the mean value over a length of path through the insulating material, which was large compared to the size of the constituent particles of the medium, and not the intensity at any particular point.

His position was strengthened by the fact that the aspects he had outlined were, in fact, the views held by most engineers and physicists who took the trouble to examine carefully what they really believed with regard to these fundamental phenomena as opposed to what they had merely accepted from previous teaching. If his views were correct, it followed that much of the criticism levelled at the B.E.S.A. Glossary at the Oxford meeting of the Association two years ago was unjustified, and many of the proposed new definitions discussed at meetings of the Committee were unsatisfactory.

Professor G. W. O. Howe recalled that he had read a paper before the Section at the Oxford meeting because some of the fundamental electrical terms in the B.E.S.A. Glossary had alarmed him and he could not see what many of them meant. Up to the present the work of the Committee which had been formed had been very useful, and, in order to remove any misconception, he pointed out that the difference of opinion which existed with regard to the definitions was not peculiar to this country or to the members of the Committee. An exactly parallel struggle had been going on for years in France, Germany and America, and none of these countries had yet been able to issue any generally accepted glossary of terms and definitions. In Germany, he believed, the divergence of opinion was even more pronounced, and the number of articles written there, discussing these fundamental terms, had been much greater than in this country. He believed the difficulties sprang from the circumstance that there were very few experimental facts, and the terms used in electrical engineering were very largely based on concepts built up to explain these facts. It was obvious that if there existed a few experimental facts, and a large number of people were trying to form mental pictures of what was happening to explain those facts, they would form different mental pictures. As a result, terms and symbols had come to connote different conceptions in different people's minds. That was somewhat the result of the change and development which had gone on in the course of years. The difficulties occurred right at the very bottom. If the Glossary had been drawn up on any consistent scheme, he would not have opposed it, even if it were a scheme which he did not agree with altogether, but his main difficulty—and he believed the main difficulty of most members of the Committee—was that it was inconsistent. The people who had drawn it up had tried to fit in some new views with the old views, and probably the trouble was due to that.

Professor E. W. Marchant, dealing with the nature of permeability and permittivity, said that when defining the two quantities generally denoted by B (flux density) and H (magnetising force) it was usual to express them both in terms of the strength of a magnetic field in a certain space. If, for example, one defined the magnetising force H acting on a piece of iron it was taken to be the strength of the magnetic field in a long narrow hole cut in the direction of magnetisation. In defining B, or flux density, it was usual to assume that it was measured by the strength of the magnetic field in an infinitely thin crevasse cut normal to the direction of the lines of force. Permeability was defined as the ratio between these two quantities, *i.e.*, between flux density and magnetising force, and it was often assumed that, since both of these quantities were measured in terms of the strength of a magnetic field, they must be of the same nature and that the ratio between flux density and magnetising force was a number. In the same way, permittivity might be defined as the ratio between the strength of the electric field in an infinitely thin crevasse cut normal to the direction of the lines of electric force, and the strength of the electric field in a long narrow hole cut along them. The same point might be made, *i.e.*, that since the two quantities were measured in terms of the same unit (the strength of an electric field), they were of the same nature, and therefore their ratio was a number. It had been shown by Maxwell that, if one took the product of these two numbers, the square root of their product was of the dimensions of $\frac{1}{(\text{velocity})^2}$

It followed that the assumption that these two quantities were numbers was wrong, and he went on to try to visualise the state of affairs existing in the medium in order to demonstrate the essential difference in the nature between B and H and between D and electric force. Taking, first, the case of the magnetic medium, he said the magnetising force acting on a piece of iron was generally represented by lines of force, these lines being drawn in such a way that the number of them through unit area normal to their direction was equal to the strength of the magnetising force. As soon as a piece of iron was placed under the influence of this magnetising force it became magnetised, and according to the theory that was usually accepted, the magnetisation was produced by turning round a number of molecules of the substance (which were permanently magnetised by the motion of the electrons in them). If one considered an infinitely thin crevasse cut through such a material, the resultant magnetic field existing in the crevasse depended:—(1) On the original magnetising force; and (2) on the magnetising force produced by the magnetised particles. If it were assumed that these magnetised particles were set in line, one could imagine that there was a string of lines of force coming from the North pole of one particle to the South pole of the adjacent particle, and these lines of force (if one could use that expression) were "generated" by the magnetisation of the particles; so that part of the magnetic field in the gap was due to the magnetising force H, and part of it to the induced magnetisation produced by the magnetised particles. The distribution of the magnetic field in the gap would be non-uniform, but it was evident that the total number of lines of force across the space would be increased on account of the additional magnetic fields that were produced by the magnetised particles. The strength of the fields so produced would clearly depend upon the magnetised particles, *i.e.*, it would depend upon the reaction between the magnetising force (to whatever cause it might be due) and the magnetised particles, which were assumed by Evershed and others to be current rings. It was to most people inconceivable that a reaction between H and the magnetised particles could be produced without the existence of some intervening medium, and it was through the intervention of that medium that the rotation of the magnetised particles was effected. It was clear from that that the strength of the magnetic field which was due to the magnetised particles must depend on the medium in the space surrounding those particles. It was in other words a property of the medium. Although permeability might be expressed as a number, therefore, it was essentially a quantity which depended on the properties of a medium when subjected to forces which produced magnetisation. In exactly the same way we could regard the electrostatic field as producing certain changes in what Faraday had called the polarised particles of a dielectric. There was a difference between the magnetised particles and the electrically-polarised particles in that respect, that the polarised particles due to an electric field were not caused by the turning of permanently electrically-polarised particles, but by the distortion of the orbits of the electrons which were rotating in those particles. The distortion of the orbits of the electrons produced the equivalent of an electric doublet which in its electrical properties corresponded very closely with the magnetic properties of the magnetised particles or current rings. (The relative increase in the electric force due to the presence of those polarised particles was very small compared with that which obtained in a magnetised substance.) It was clear, however, that the electrical moment of the polarised particles in a dielectric depended on the medium which transmitted the electric force to them. If, therefore, the strength of the electric field in a crevasse cut through the dielectric normal to the lines of electric flux were measured, an average value of electric field strength which would depend on the number, distribution and polarisation of the polarised particles would be measured. Hence permittivity also was a property of the medium surrounding the polarised particles. The permittivity or specific inductive capacity of a substance, therefore, depended essentially on the behaviour of that medium when transmitting an electric force. Although permittivity from one point of view, therefore, might be regarded as a number it was essentially a quantity which depended on the properties of a medium when transmitting electric forces. Both permeability and permittivity, therefore, depended on the properties of the ether (if one called the medium the ether), and if that were so, then it was easy to understand that the quantity which was represented by the square root of their product was something which was not merely a number but which depended on the magnetic and electrical properties of a medium when transmitting magnetic and electric forces, and which, therefore, determined the velocity of an electro-magnetic wave transmitted through it.

Professor F. G. Baily said he had endeavoured to draw up something equivalent to the first dozen pages of the B.E.S.A. Glossary, which pages were devoted to the fundamental electrical terms. There was great difficulty in drawing up any set of definitions, because, while the professors felt that they must be philosophically accurate, at the same time, if their definitions were to be of any use, they must not only deal with the wording and ideas used by practical engineers, but must fit in with the way in which the practical engineers used their expressions. A good deal of the difficulty was experienced in endeavouring to meet both sides, because the practical man used words in a way which he found convenient to himself, regardless of whether they were philosophically accurate or not.

Professor W. Cramp, after discussing with Sir James Henderson some of the points raised, said it was apparently agreed that the crevasse slot system would give a reasonable basis on which the Glossary might be framed. He asked if others agreed with that view.

Sir James Henderson replied that he did.

Professor Cramp said it seemed to him that that was the solution of the problem so far as the Glossary was concerned.

It was stated at the conclusion of the Section G meetings that Professor F. C. Lea may possibly act as President of the Section at the South African meeting next year.

Rationalisation and Industrial Education.

On Wednesday, September 12th, Major L. Urwick (Management Research Groups) read a paper on "Rationalisation" before Section F, in the course of which he discussed the significance of rationalisation, and levelled some criticism at the educational and business organisation in this country.

Referring, first, to the difficulty of defining "Rationalisation," he said that in 1927 the Economic

Conference at Geneva, representative of the whole of the industrialised nations, had passed unanimously a series of remarkable resolutions, to which was given the title of "Rationalisation," but it was apparent that there was a little uncertainty as to definition. Each of the developments noted by the Conference in the discussions, however, attempted to eliminate some particular form of industrial waste. But each and all of these wastes were of a special kind: they were failures of competitive individualism to function effectively in its present form, and with its existing range of ideas. Collectively they constituted a tremendous departure from the pure theory of *laissez-faire*, and a departure in a new direction. These developments adumbrated entirely new forms of co-operative action between those engaged in economic activity, and a view of economic process which necessarily looked beyond self interest, since it contemplated deliberate planning for periods far exceeding the lifetime of the individual.

It was not possible, he said, to give a definition of rationalisation which referred to concrete phenomena. It was not a particular method of organising an industry, nor was it any system or device which could be shown in operation in one factory and not in another. To use a phrase so frequently applied by F. W. Taylor, to scientific management, it was a "mental revolution." It was at once an attitude of mind and a process. As an attitude of mind it implies the belief that a more deliberate control of world economic life through the application of scientific method was possible and desirable. As a process it involved the application of the methods and standards of science to all the problems arising in the organisation and conduct of production and distribution. Its consequences for those who were primarily interested in the education of the future generation of industrial administrators were far-reaching.

There was little question, he said, that the provision for research and education in Great Britain was inadequate. It did not meet the requirements, either of our great industrial tradition or of our minimum future needs. There was, of course, a large variety of useful and valuable institutions, and he mentioned particularly the department of Scientific and Industrial Research, with its trade research associations, and numerous special laboratories. But research was one thing and the translation of its results into daily industrial practice was another. Directors of research in many industries stated frankly that it was their daily experience to find that employers were totally unable to make use of important technical discoveries owing to the inadequacy of their administrative arrangements. Instances were common where individual concerns had spent large sums in investigating questions on which full published information was already available.

It was perhaps significant in that regard, that in Great Britain in 1926 there were less than a thousand students in the institutions offering university training in industrial administration. In Germany there were sixteen thousand, and in the United States more than eighty thousand. It was at present the custom for professors of commerce to bewail the narrow-mindedness of employers, and for employers to decry the futility of university courses in commerce. But mutual recrimination was a symptom of disease and not a treatment.

The present position seemed to involve two difficulties. University courses in business administration had not been so framed or conducted as to appeal to the best type of student, or to produce the type of young executive which business required. On the other hand, the majority of English businesses were so organised that it was extremely difficult for them to recruit and develop men who had enjoyed a University training. There was a vicious circle; any attempt to break it could only be successful if it came from both sides.

Indicating one or two directions in which practical action might be taken, he said that in the first place, while the majority of our Universities expressed great enthusiasm for obtaining the co-operation of business men in framing their courses of study, their practical arrangements to that end frequently left much to be desired. There was a tendency to appoint some sort of consultative committee with powers and responsibilities which were extremely vaguely defined. The *personnel* of such committees on the business side was all too frequently recruited, not from active administrators in the prime of their business careers, but from retired notabilities who had long ago left the executive side of their business lives behind them. They naturally inclined to press for a type of education which would produce the kind of subordinate they would have liked the day before yesterday. They were usually unable to contemplate a form of training superior to that which had loosed their own peculiar abilities upon the world.

In the second place, existing degrees of commerce presented a variety of syllabuses only exceeded by the difference in the standard which they demanded from students. A degree of commerce in Great Britain at the moment meant almost less than nothing, and it was not to be wondered at that the conductors of business offered the possessor of such a degree £3 per week. It did not indicate in any single instance that the student had reached any recognisable level of attainment in any one of the half-dozen fields of knowledge which might be regarded as the essential equipment for the administrator.

The methods of teaching were equally variable. That was largely a matter of finance, and there again the vicious circle must be broken. The business man would not pay for education which he felt to be useless. In the majority of instances we were still tied down to the lecture hall and the scheduled examination. An indication of a lack of alertness on a vital question was the fact that no experiment had been made in this country on the lines of the Case method of instruction as applied at the Havard School of Business Administration, which method at least provided a point of contact between the University and the practical conduct of business enterprises. No effective organisation existed for comparing method and co-ordinating the work either of the various faculties of commerce or of the numerous research, technical and professional institutions concerned with industry. On question of management and administration there was, practically speaking, no research at all and no facilities for it.

Probably one of the chief difficulties was the idea among educationalists that the teaching of business must necessarily be purely vocational and technical. They aimed at a form of training designed to equip their students to earn £3 a week when they left the University, rather than £30 per week in fifteen years' time. They regarded business training as a whole as a rather unpleasant Cinderalla of the academic household.

Business administration was a subject as suitable for a wide course of humaner studies as history or philosophy. Business men and educationalists must come together on this problem, not as men of diverse world mouthing inanities about commercial experience on the one hand and academic experience on the other, but as joint trustees for the future leadership of the nation. Only by facing the fact that education is a continuous process throughout the life of the individual, a process to which they both contribute, could they arrive at a common standard and an agreement as to how that standard might be attained. Secondly, the shopkeeper's view of business training must go.

The Coal Dust Motor.

AT the June annual meetings of the Verein Deutscher Ingenieure, which were held in Essen, one of the most interesting papers read before the internal combustion engine section was that by Dip.-Eng. R. Pawlikowski, of Görlitz, who dealt on June 9th with the burning of coal dust and other powdered fuels in an internal combustion engine. From an account of this paper published in the V.D.I. *Journal* some of the following particulars are taken.

Mr. Pawlikowski was, in the period 1896 to 1898, chief engineer to the late Dr. Diesel, when he was at Augsburg. Beginning in 1911, he has carried out at the Kosmos Works

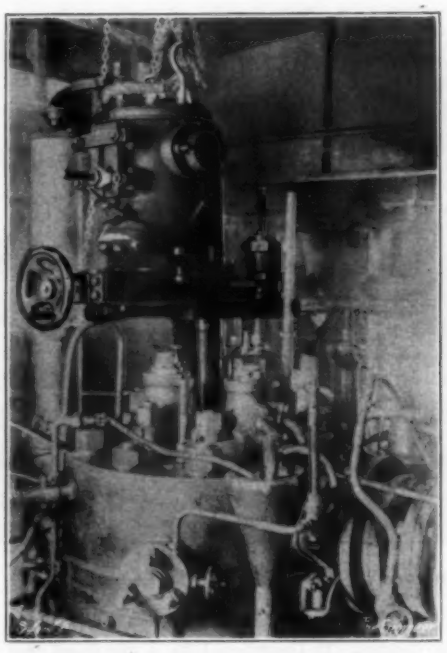


FIG. 1—COAL DUST HOPPER AND FUEL VALVE

in Görlitz, of which he is the proprietor, extensive experiments on the use of powdered fuel. For this purpose a single-cylinder four-stroke cycle 80 brake horse-power M.A.N. type motor has been employed. It was built in Augsburg in 1906 and has a bore of 420 mm., or a little over 16½in., with a stroke of 630 mm., or about 24¾in. The engine is designed to give the above-mentioned output when running at 160 revolutions per minute. Before it was purchased and rebuilt for coal dust experiments the engine had been employed in a chemical works and the top of the liner had been increased during this period of service by 1 mm. to 421 mm. diameter. As equipped, for use with coal dust, oil, or both these fuels the engine has run, without deposits of ash in the cylinder or unusual liner wear.

After upwards of 9000 working hours' running on coal the cylinder liner has increased in diameter to 425 mm., while at the lower part of the liner the 420 mm. diameter remains and the turning marks are clearly seen. The stuffing-box has not been renewed and the original piston is still in use, the piston rings having been renewed several times. Under these conditions the compression is 30 atmospheres, or about 428 lb. per square inch, and the engine is used continuously for driving the factory. Typical indicator diagrams for light and full-load conditions showing the governing are reproduced in Fig. 2. The fuel employed during these tests was an Ilse lignite.

Using the experience already gained, a 40 brake horse-power horizontal engine of the Deutz pattern and a 25 brake horse-power two-cycle hot bulb engine are now being rebuilt for use with powdered coal, while we are given to understand that experiments are to be made with an engine of 1000 brake horse-power working on the same principle.

The fuels which have been tested include anthracite, bituminous coal, charcoal, turf, lignite, rye dust, and blast-furnace coke. It is found that fine grinding is essential and the poorer the fuel and the higher the ash content the more finely ground must the fuel be. With an ash content of 16 per cent. it is found better to mix, say, 80 per cent. of this fuel with 20 per cent. of powdered lignite. With such a fuel powers up to 110 brake horse-power on the brake have been obtained. Over 500 different kinds of injection nozzles and arrangements have been tried. A mean indicated pressure of 11·3 atmospheres, or 160 lb. per square inch, with a pressure of 3·6 atmospheres, or about 50 lb. at the end of the expansion stroke is now obtained. It has been shown that the fine particles of coal enter the highly compressed air quite as well as those of oil, with probably deeper penetration and correspondingly good combustion.

By careful design it has been possible to keep the ash away from the piston liner and valves. At 87 brake horse-power the engine uses 36 kilos. of lignite per hour, which

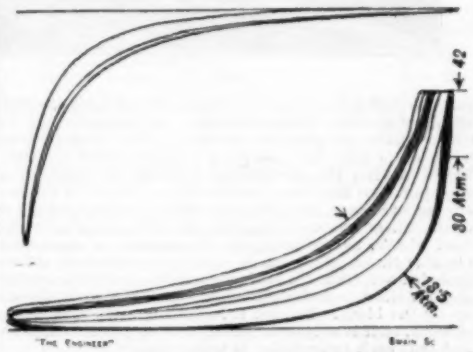


FIG. 2—LIGHT AND FULL LOAD DIAGRAMS

as dust costs about 0·47 marks and contains 10 per cent. of 3600 grammes of ash, so that at each stroke there is about 0·86 gramme of ash to each 100 litres of cylinder volume. The exhaust gases are clear and do not, it is stated, contain tar or lubricating oil.

Fig. 1 shows the type of coal chamber employed, which is arranged so that it is complete with its governor-controlled coal dust regulating valve, so designed that the hopper can be fitted into the ordinary fuel valve seating. As illustrated, the hopper chamber is withdrawn and is hanging above the cylinder cover. Both open and closed systems of working for the hopper have been used, and air injection has been employed, as well as the ante-combustion chamber system of working. The indicator diagrams we reproduce in Fig. 2 show that the smallest charges of fuel are ignited. It is found that the compression pressure of the engine may be utilised to heat the air and also prepare the fuel for injection into the cylinder, both remaining apart until the ignition point is reached, a method of working which would seem to adapt the engine for high-speed work. At first the ash was kept from the piston rings by using an air pressure of about 800 lb. per square inch, which was injected behind the rings, but a later method has been perfected whereby the rings are washed with oil. A larger amount of lubricating oil is needed, but this can be centrifuged and re-used. Drawings of the double-seated coal dust filling valve, the governing arrangements, and the circulation and warming of the coal dust by the exhaust gases cannot be published at the present time, but some idea of these essential parts may be obtained by consulting the patent drawings. The paper given by Mr. Pawlikowski certainly shows that a great deal of progress has been made in the direction of the burning of solid fuels in powdered form. There is no doubt that when the system has been finally perfected and developed for large powers there will certainly be a wide field of application for the coal dust motor on account of the lower cost of operation.

A British Road Grader.

A BRIEF reference was made in our issue of June 29th last to some trials of a road grader, made by J. and F. Howard, Ltd., at Bedford, and we are now able to publish herewith an illustration of the machine at work.

The grader in question has a blade 7ft. 3in. long, and is modelled on broad lines on experience which has been gained on the American Continent. The machine is, however, entirely of British construction, and embodies several refinements not found on American graders.

The object of a grader is, of course, to distribute the local soil, by means of a curved blade set at an angle to the direction in which it is drawn, so as either to smooth out humps and hollows in the surface or to move the soil bodily sideways to form the ditches and crown of the road. It will be readily understood that to perform these various functions the blade must be adjustable in a number of directions. For instance, its horizontal and

ROAD GRADING MACHINE

J. AND F. HOWARD, LTD., BEDFORD, ENGINEERS

vertical angles, its height and its transverse position must all be adjustable. Several of these adjustments may be effected while the grader is travelling, and for that purpose worm gears have been adopted in the Howard machine. The worm has the advantages of giving the operator a good purchase and being irreversible, so that stop catches are not necessary, as is the case where toothed gearing is used. There are also arrangements for canting over the road wheels, as shown in the illustration, to counteract the side thrust of the blade and to accommodate differences in level, while the back axle can be extended on either or both sides to make the wheels clear the spoil thrown up by the blade. In fact, it looks, when the machine is at work, as if it were articulated in every possible manner and that each articulation is under control.

The general structure of the machine can be followed in the engraving, from which it will be seen that the backbone of the framing is composed of two arch-shaped T sections braced together at frequent intervals. This frame is for the purpose of carrying the control gear and spacing the wheels. It takes no part in the traction of the grader blade, which is attached to a turntable, the pivot of which is directly connected with the draw gear. The draw gear, by the way, includes a pole, which can be slewed over by the chains shown in the engraving, so that the tractor can travel in a different line to the grader, and get the best running ground. It will be noticed that the wheels have concave rims to give them a good grip.

On the occasion of our visit to Bedford, this grader was drawn by a 30 horse-power tractor running on paraffin, made by Peter Brotherhood, Ltd., of Peterborough. In conjunction with another, lighter, grader, a scarifier and a Barford and Perkins 8-ton crude oil roller, it was set to work on a stretch of typical Bedfordshire soil to make a dirt road. The soil had already been stripped of its grass. We need not here go into the process of making a "dirt" road, and it is sufficient to say that the scarified surface is gone over by the grader to gather up the soil from the sides to form the crown of the road and the ditches at the sides. The formed road is then rolled to solidify it.

This process was carried out over a length of 100 yards or so, and although in the time at our disposal it was not possible to study the road after it had been completely rolled, it was evident that, in reasonably skilled hands, these machines will produce excellent results. At our special request, the grader was taken off the cleared surface and set to work on a very rough piece of grass land, and it was then that the photograph from which our engraving was prepared, was taken. Unfortunately, some wire guys were an obstacle to a continuous run, but during the few yards it was possible to keep the machine going it took this rough service readily. Incidentally, the test demonstrated the handiness of the grader in manœuvring.

Two New Concrete Bridges in New Zealand.

ABOUT thirty-four years ago a bridge, about 224ft. long, was erected over the Tiraumea River at Ngaturi, in New Zealand. The bridge, which at the time it was built was regarded as a very fine structure, consisted of two spans of "bow string" trusses built from Totara timber cut in the district. In December, 1925, it was found that in certain parts there was serious decay, and the bridge was condemned as being unsafe for anything but light traffic, and not safe even for that unless an expenditure of about £800 were incurred. It was agreed by the Highways Board that it should be replaced by a modern reinforced concrete bridge, capable of serving the needs of the district, and the present structure, 18ft. wide, is the result.

Work was begun in November, 1926. The deck level being some 55ft. above the river bed, the procedure adopted was to build the new piers almost up to the old bridge before closing and removing the old structure, thus giving light traffic the use of the old bridge for the summer months. At the end of February it was closed and the superstructure removed and used for falsework in the new construction. The bridge itself was completed in the following September, but wet weather delayed completion of the approaches to carry heavy traffic, although light traffic was carried in November.

The new bridge is of reinforced concrete of the girder and slab type. The total length is 210ft., comprising two spans of 60ft. and three of 30ft. The roadway between kerbs is 18ft. wide, to take two-way traffic. The overall width is 20ft. 8in. The deck level is 55ft. above the river bed and 47ft. above summer water level. The piers are all founded on solid papa, and the two abutments and the wings are carried on reinforced concrete piles driven in papa.

There were used in construction 980 tons of concrete and 15¼ miles of steel bars of varying sizes. The bridge is designed to carry any traffic that is reasonably likely to want to cross. Mobs of cattle without restriction may be crowded on to it, and two traction engines with trailers may pass on it anywhere.

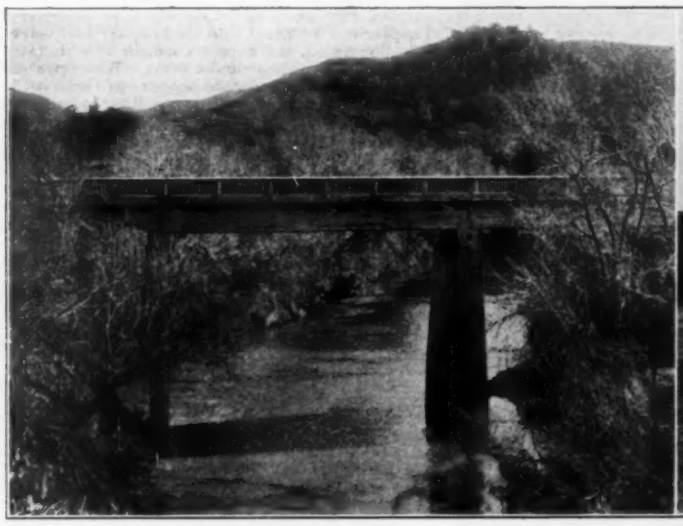
The cost of the bridge, including the approaches, &c., was £6249.

A bridge on Wellington-Napier Highway, at Mangatainoka was built about forty-six years ago. It consisted of three truss spans, with a total length of 224ft., and it also was constructed of Totara wood, the north abutments being of concrete. It did good service, but old age and decay caused it to be condemned, the Council's engineers reporting that it was in a dangerous state for the traffic that was using it, and about a year ago the Highways Board concurred with the Pahiatua County Council that a new bridge was necessary.

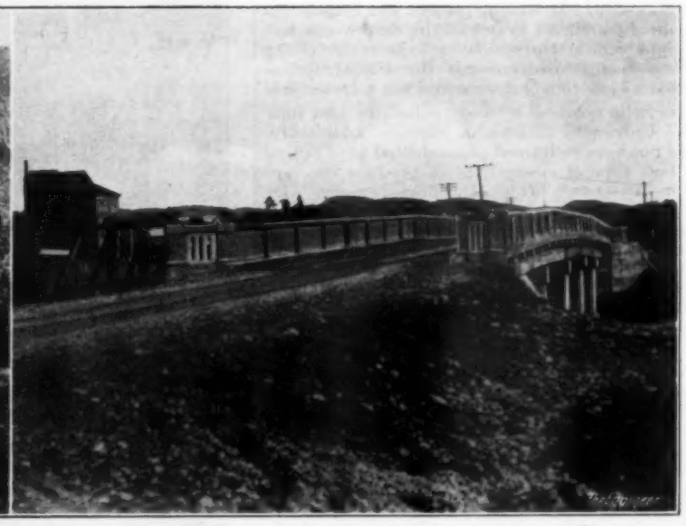
A modern bridge of reinforced concrete of the slab and girder type was designed. The site is immediately upstream from the old bridge. Considerable difficulty was met with in sinking the two first piers, the bed of the river consisting of about 10ft. of shingle overlying papa. Frequent floods and submerged logs made cofferdam construction difficult, but eventually the obstacles were overcome and the bridge completed. It is designed for the same loads as the Ngaturi Bridge and is of the same width. There are six spans of 40ft., giving a total length of 240ft. Two spans at each end are on a gradient of 1 in 40. Four piers and one abutment are founded on reinforced concrete piles sunk into papa. One pier and one abutment are founded on papa. The deck is 24ft. above the bed of the river, or 19ft. above summer water level. The amount of concrete used was 830 tons, and length of steel bars 17 miles.

The total cost, including approaches, &c., was £6125, one-half of which, as with Ngaturi Bridge, is borne by the Highways Board. Completion of the new bridge was made none too soon, for about a month before it was finished, in spite of temporary repairs, one span of the old bridge seriously failed and traffic had to be limited to very light vehicles only.

The bridges described above are a few miles apart, and both structures were officially opened by the Prime Minister, who was accompanied by the Minister of Public Works, the ceremony taking place on Saturday, June 30th, 1928.



CENTRE SPAN OF NGATURI BRIDGE



MANGATAINOKA BRIDGE

LARGE AMERICAN ELECTRIC EXCAVATORS.

FOR open-cut coal mining where the coal seam is some 60ft. below the ground, electric excavators are being built in the United States with buckets of 12 yards capacity. This stripping is on all kinds of material, including earth, gravel, shale and rock. The foundation is a heavy plate girder frame mounted on the caterpillar type of travelling supports in such a way that the frame has a three-point bearing. A turntable on this frame carries a revolving plate girder frame upon which is mounted the machinery. At the forward end of this revolving frame is the 95ft. jib or boom carrying the 60ft. bucket handle, both of steel construction. The head of the jib has luffing tackle leading to steel A-frames on the revolving frame and thence down into the cabin. With a cutting 55ft. deep the bucket takes its load in 15 to 18 seconds; the machine then swings 90 deg. to 120 deg. to discharge the material into the pit from which coal is already mined, and then swings back for another load, completing the cycle in 45 to 55 seconds. The loaded bucket represents a weight of 35 tons on a radius of 103ft. The motors are operated on 4000-volt current supplied through a cable mounted on a motor-driven reel. Two speed reduction gears are placed between the motors and main hoist. Working twenty-four hours a day, with one operator, one oiler and one or two pitmen on each shift, the machine excavates about 300,000 cubic yards in a month.

Iron Ore Mining in Vizcaya.*

By JOSE BALZOLA, Mining Engineer (Bilbao, Spain).

THE surface of Vizcaya consists principally of rocks of the Cretaceous period. The mineralised zone is represented by a bed of a fossil-bearing limestone of the Aptens period, the fossils being of marine origin, principally corals, requenias, and ostreas. The ore replaces this limestone at times completely, at others partially or not at all.

The Bilbao ore deposit is on a wide anticlinal fold, the axis of which, running N.W.–S.E., is denunded, showing bare the lower shale. The strata dipping S.W. are represented by the Galdames group of mines, that dipping N.E. by the Triano and Matamoros mines. The deposit extends S.E. through Bilbao as far as San Miguel de Basauri, and N.W. to the Province of Santander by Setares and Dicido, some 24 kiloms. long by 6 kiloms. wide.

The district is cut by numerous faults, some with throws of 60 m. or more. Mineralisation has been produced after the faulting by hydrothermal springs, which, saturated with carbonic acid and charged with ferrous carbonate, resulted in the replacement of the limestone by the latter, and formed carbonate of iron or spathic ore. The intensity of the mineralisation bears a relationship to that of the fissures caused by the faults, and so the ore bed follows the longitudinal faults, and has its maximum importance at the junction of these with the cross faults. The thickness of the ore-limestone bed varies between 90 m. and 30 m., having been mineralised in places to a potency of a million tons per hectare, as in Parcocha and Concha 1.

Spathic ore has a density of 2·8 to 3; it appears in two classes, "grey" and "white." "Grey" spathic is the primary ore, and is composed of small grey and white granules, harder and more siliceous and higher in sulphur than the "white." "White" spathic ore is creamy-white, composed of crystals of siderite derived from the "grey" spathic by a process of solution and crystallisation. It disintegrates more easily on calcination than does the "grey." Spathic ore is bespattered with tiny crystals of iron pyrites, which render the ore high in sulphur. The actual production of spathic is roughly one-third of the total output.

The more common oxide of iron is Rubio, a hydrated ferric oxide, brown hematite or limonite, derived from the oxidation of the carbonate. It has a density of from 2 to 2·5, and occurs in cellular or concreted forms. The oxidation has commenced on the periphery and has continued inwards, as can be seen by the nucleus of spathic still remaining in many blocks of the ore. Vena and campanil are red hematites, both, like Rubio, derived from the oxidation of the carbonate. Vena is a soft purple compact or powdery mineral, the purest of the Vizcaya ores, and that originally used exclusively in the old Catalan forges of the country. Campanil is an epigenesis of the white spathic ore, and is compact and crystalline. Its name is derived from the bell-like sound (*campana*) emitted when it is struck with a hammer. The composition of the gangue of campanil is nearly self-fluxing, and this property, combined with its easy reduction, makes the ore ideal for the Bessemer process. Both vena and campanil are fast becoming extinct, particularly the former. Their production is restricted to a few mines and does not exceed 100,000 tons per annum. Chirta is a gravel-like ore, composed of concretions or nodules of red or brown hematite surrounded by clay. The name has been extended to clays now loaded from old rubbish tips for washing purposes.

Table I. shows typical analyses of ores in the Bilbao district.

TABLE I.—*Analyses of Vizcaya Ores.*

	First-class Rubio.	Second-class Rubio.	Campanil.	First-class calcined Spathic.	Second-class calcined Spathic.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Ferrous oxide ..	—	—	—	1·00	0·52
Ferric oxide ..	77·479	70·710	84·00	81·62	71·39
Silica	9·18	16·40	3·20	9·03	17·00
Alumina	1·76	1·89	—	1·37	2·70
Manganese oxide	1·11	0·77	1·90	1·39	3·50
Lime	0·10	0·45	4·60	1·39	3·50
Sulphuric acid ..	—	0·32	—	—	1·07
Sulphur	0·055	—	—	0·426	—
Phosphoric acid	0·052	0·078	Trace	0·032	0·032
Loss on calcination	10·00	4·00	6·30	1·90	2·67

The averages for first-class Rubio and Spathic ores are :—

	Per cent.	Per cent.
Moisture	8·20	2·19
Iron, dry	53·95	58·70
Iron, moist ..	49·53	57·42
Silica	10·26	7·97
Sulphur	0·028	0·368
Phosphorus ..	0·017	0·007

The moisture varies considerably with the weather.

Working.—The majority of the mines are worked in open-cast, with benches 20 m. to 30 m. in height, which are connected by railways or inclined planes. The explosive in general use is dynamite. Drilling is done either by hand or by compressed air. Compressed air for drilling has been introduced into a great many of the mines. The favourite tool is the "hammer-drill" of 12 kilos. to 20 kilos., served generally by two drillers. The men of the district are skilful in the use of hammer-drills, and it is general practice to drill holes 6 m. to 6·5 m. long with these small hammers.

Blasting.—After drilling the hole a chamber is blasted at its extremity to concentrate the charge of explosives. Blasting is not done according to any set rules, but follows the judgment of the foreman, who determines the position of the hole and the charge. It is carried out at lunch time and at the end of the day's work.

Holes are generally marked, not so much with a view of breaking the ore to a suitable size for loading, but rather of making the largest volume with a minimum of explosive. This involves a great amount of secondary blasting. Sometimes the amount of explosive used in the secondary blasting reaches ten times that of the main charge. Formerly higher working faces were allowed, with the consequent necessity of more secondary blasting. In early times a shot of 3000 tons was usual; to-day shots of 500 tons are considered large.

Loading of Wagons.—Once the rock has been blasted to about 0·5 m. size, when it is no longer economical to use explosive, it is broken by hammer to the necessary dimensions for classification and shipment. No mechanical crushers are yet used, but in the general trend towards mechanisation it is more than possible that they will soon be introduced. In a spathic quarry, for example, 20 per cent. of the loading men are employed breaking stones.

Of late years power shovels have been coming into general use. The first to use shovels in the district was the Orconera Company in the early 'nineties for the overburden of Orconera 5. This attempt was not successful and the shovel was abandoned, but at that time labour was very cheap† and the steam shovel was in its infancy. To-day circumstances have altered. Shovels are stronger, more reliable, and much perfected, and labour is paid 7 to 7·5 pesetas for the legal shift of eight hours, as against 3·75 to 3 pesetas formerly for the ten-hour shift.

Several years ago the Dicido Company installed at its mine in the Province of Santander the Bucyrus 2¼ yards dipper railway type "C" shovels. Each shovel is served by small steam locomotives, and the distance between the face and the tips is very small, 300 m. to 600 m. The production of this shovel is about 500 to 600 cubic metres, reaching sometimes 1000 cubic metres. The benches are very high, and the overburden is blasted down before loading begins. These shovels are very rapid in their movements, taking an average of 25 seconds for a complete dipper swing.

In the Vizcaya mines small shovels are now being used with great economic advantage, both in the Bilbao and Orconera mines, on overburden and on the re-working of old tips for washing purposes. The wider applicability of mechanical loading is at present merely a problem of classification and picking, the importance of which is self-evident where ore is concerned. In the case of old rubbish tips worked for washing purposes the importance of sorting is dependent on the length of transport to the washery, abundance and cost of water, settling marsh, and dumping ground, and these factors are decisive in methods of loading. The Orconera Company has recently had highly satisfactory and efficient results in experiments with belts in combination with steam shovels.

Mine Transport.—The Bilbao district has a great variety of haulage systems, already enumerated and detailed by Gill, some of them like the Orconera main incline plane, still a model of its kind. These systems have undergone few changes since 1896 other than in details, and in the almost general trend towards the substitution of steam by electricity.

The Concha 2 mine is the chief source of that company's spathic ore; it is worked in part by opencast and partly underground.

The mine is divided into five principal levels, each one being some 25 m. high, joined up by means of chainways which deliver the products into a central installation where two lines of aerial ropeways commence, one line for the ore, one for the rubbish. The chainway tubs, of 50 cm. gauge, are about 60 cm. high, with a capacity of 1000 kilos. of ore. The links of the chain measure 15 mm. and 26 mm., and the weight of the largest chain is 16 kilos. per metre. The capacity of the ropeway buckets is the same as that of the tubs; it thus being possible to transfer direct from wagon to bucket.

The installation is excellently arranged, advantage being taken of the change in direction for coupling up the chains on different levels. The speed is regulated by means of brakes and revolving balanced wheels, which generally turn in water in order to avoid increasing the size of the blades. The capacity of the installation depends on that of the ropeway, which is limited to 370 tons per hour.

The central transfer station, where the products are transferred from the tubs to the ropeway buckets, consists of several revolving tipplers arranged in series on a closed circuit railway line, with the gradient in favour of the load. Tippling takes about 40 seconds.

Arguments in favour of the chainway system are :—Greater facility for hand loading, because of the lower height of the tubs, which gives the loader a 15 per cent. greater efficiency; better adaptability to the irregularities of the ground, smaller curves, less excavation for lines, and a high yield per man on transport, when the installation is working to its full capacity.

Arguments against that system are :—The necessity of breaking rocks small so as fully to utilise the tubs, difficulties in combining with mechanical loading, higher first cost, and difficulties in cutting down the number of men on transport work when the production diminishes.

The underground portion of the mine will be served by a main shaft equipped with two cages, and placed adjoining the central transfer installations. The underground tubs will be the same as those used on the surface chainway and will pass on to the same transfer installation.

Besides the main shaft there is a shaft at the higher part of the mine and an auxiliary shaft at the level 365. The principal data of the main shaft are :—

Diameter of shaft	7 m.
Depth	70 m. to 250 m.
Net load	2000 kilos.
Weight of cage	2000 kilos.
Weight of tubs	2000 kilos.
Diameter of cable	33 mm.
Weight of cable	3·73 kilos. per metre
Diameter of drums	3·200 m.
Width of drums	2·600 m.
Motor	170 to 270 H.P.
Motor, revolutions per minute ..	275
Drum, revolutions per minute	22

The motor is a three-phase machine operating at 220 volts. One of the drums is adjustable in relation with the other. The usual safety devices are provided. The head frame is 31 m. high, the pulleys are 3·5 m. in diameter. The total weight of the headgear with accessories is 130 tons. The ventilation shaft is 3·80 m. in diameter and 116 m. deep. The auxiliary shaft is 65 m. deep and 4·80 m. in diameter. The normal capacity of the installation is estimated at 1500 tons per day. At present the ventilation shaft is completed and the main shaft has been sunk to a depth of 157 m. The head frame and one of its two winders are also finished. The main galleries have also been cut through, and only a few details remain to be completed before commencing extraction. The system of exploitation is not yet fully decided upon; to begin with, it is to be the room-and-pillar method followed by filling.

Aerial Ropeways.—Aerial ropeways are particularly well adapted to the hilly nature of the Vizcaya district and to the numerous obstacles in the way of establishing railway lines. The original Hodgson ropeway described by Gill is still to be seen, though reduced to-day to two lines of buckets.

There are, besides, a series of mono-cable ropeways in different mines. The most important ropeways in the district are those of Orconera, Franco-Belga, and that recently erected by Parcocha. These three are all twin-cable ropeways on the Bleichert system.

Orconera Ropeway.—This carries ore clays from the mine station at Carmen VII. to the washery by the sea at Poveña. The washed ore passes through a bunker and is carried by the return buckets as far as Pucheta. The buckets here empty into another bunker, and continue their journey empty back to the mines. From Pucheta a branch ropeway carries the washed ore to a third bunker at the company's railway terminus at Gallarta. The branch carrying clays from the mines to Poveña is a double-return installation, that from Pucheta to Gallarta a single-return installation. The characteristics of the Bleichert system are too well known to need description here. The principal data are as follows :—

Distances.	m.
Carmen to Poveña	8066
Carmen to Pucheta	3710
Pucheta to Gallarta	1800
Levels.	m.
Height of Poveña above sea level	90·20
Difference in level between :	
Carmen and Poveña	242
Pucheta and Gallarta	128
Speed, 2·5 m. per second	
Space between buckets, 64 m.	
Capacity.	Tons per hour.
Main lines; clays	220
Main lines; washed ore	96 to 120
Branch (Poveña to Pucheta)	82 to 100
Loads.	Kilos.
Load per bucket; clays	740 to 750
Load per bucket; washed ore	800 to 1000
Load on branch	610 to 750
Power.	
Carmen VII. station : Two 100 H.P., 3000-volt motors.	
Gallarta station : One 100 H.P., 3000-volt motor.	

Only one of the two motors of the Carmen station is working normally, consuming 14 to 16 ampères. The Gallarta motor absorbs 20 ampères.

The complement of men on this ropeway totals ninety, of which nine men are employed inspecting the line and on light repairs. The maximum distance between trestles is 200 m.; the tallest trestle is 28·5 m. high.

Franco-Belga Ropeways.—The Franco-Belga ropeways are, like those of the Orconera Company, on the Bleichert system, the carrier being suspended on two wheels.

Parcocha Ropeway.—This is the most modern installation in the district. It transports ore from Parcocha Mine to the station of Arcocha on the Triano Railway. This installation, also on the Bleichert system, has carriers suspended on four wheels so as to diminish the flexion of the cable. The ropeway has a total capacity of 700 tons per day, a net load per bucket of 850 kilos., and a speed of 2·25 m. per second. The complement of men is twenty-one, including the loaders and unloaders at the stations. The general arrangement of the stockyard is efficient and allows the buckets to be unloaded at any point in the dump. The cost of reloading from this stockyard into railway wagons is 8 to 10 centimos per ton—under 1d.

Ore Washing.—The problem of washing the "chirtas" of Vizcaya, as also those of the adjoining province of Santander, is at present almost reduced to the separation of the clay from the ore by using large quantities of water in a trommel or beater. When the clay has been washed away by the water the ore is spread out on belts or turn-tables. The installation owned by the Orconera Company in Poveña is representative of the system of washing plants in Vizcaya.

The Orconera Company has such a large quantity of clayey ore that it was impossible to find sufficient quantities of water for treating it at the mines. The company decided, after considering the possibility of bringing sea water and sending the slimes to the sea, to erect the ropeway described, in order to carry the clays to the sea at Poveña, where the washing would be done.

The installation has a capacity of 180,000 tons per annum (washed ore) for clays containing about 40 per cent. of ore. The ropeway buckets on arrival are discharged on to a dump, whence, by means of six hose pipes, the clays are washed into the trommels. The number of revolutions per minute is 7 to 8. These trommels are driven by a 165 horse-power motor, which transmits power to three shafts placed above each group of trommels by means of a rope drive.

The pumping installation is composed of two 260 horse-power pumps which raise the water from the sea to a height of 90 m. One of the pumps is kept in reserve. The large motors operate on 3000 volts; the remainder work on 220 volts.

The output from the picking belt is some 450 kilos. per man, varying to some 700 kilos., according to the size of the ore. The fines (ore smaller than 5 mm.) usually constitute 4 per cent. of the total. The analysis of the lumpy ore on the dry weight gives 55 per cent. of iron and the fines 46 per cent. The fines, besides having a smaller iron content, are also higher in phosphorus.

Nearly all the washeries in the district have the same type of plant as that described. Recently, washeries have been erected where the fines pass through jigs, and good results have been obtained. These jigs, installed in the mines "Elvira," "Berango," "El Morro," and "San Luis" are the result of the work of the mining engineer, Don Jesus Arana.

Calcining Spathic Ore.—In the early times the fines of the spathic ore were separated, and the first attempt in the district to calcine spathic ore was made by the Franco-Belga Company. This was successful, and then several kilns were constructed in the district. All these kilns have been of the stack type. It was also the Franco-Belga

* Iron and Steel Institute.—Abstract.

† See Gill's paper, *Journal* of the Iron and Steel Institute, 1896, No. II., p. 36.

Company that introduced the use of forced draught, which was later adopted by several other companies. Most of the kilns are cylindrical with four doors for the discharge of the calcined ore, but the Franco-Belga Company has now adopted a type of kiln elliptical in shape and lower than the generality. In general, the production of the kilns per shift has been about 0·6 to 0·7 tons of calcined ore per cubic metre of capacity. At the present time the problem of increasing the production per kiln has taken another turn, the present general manager of the Orconera Company, seconded by his mechanical staff, being the pioneer of this task. The results have been brilliant, and the production has increased 1·2 to 1·5 tons per cubic metre of capacity per shift.

Orconera Iron Ore Company, Ltd.—This company has twelve kilns grouped in batteries of four. All are situated near the main railway. The batteries of kilns 1 to 4 and 9 to 12 are in line and at the same level as the railway. The 7·5-ton hopper-bottom railway wagons of spathic ore are raised by a double-acting electrically operated incline and are run directly over the tops of the kilns. The direction of this incline is at right angles to the line of kilns, and is placed at the middle of the battery. The wagons are moved from the head of the incline to and from the kiln, where they are discharged by an endless rope which passes through two grips on the tractor. The capacity of each of these kilns is about 100 cubic metres. The height is 12·50 m. from the base to the top, and the cones are about 2 m. high. The diameters are 4·10 m. and the kilns are cylindrical in form. The insides of the kilns are of fire-brick and the outsides are common brick bound with iron bands at intervals.

The discharge is effected through openings placed symmetrically, which are shut by means of iron doors; screws make the joint between the door and the kiln air-tight.

The air is distributed from the centre of the cone, and also through points in the doorways. The cones, which are made of steel plates, are very steep, to facilitate the discharge of the calcined ore. One-fourth of the calcined ore is held in the kilns by means of two gates in each opening. These gates are pivoted and in their natural positions are shut. When it is desired to discharge a kiln the gates are raised from the outside by means of shafts passing into the kilns, whose inner ends have chains joining them to the gates. These chains wind round the shafts, thus raising the gates. The calcined ore flows easily without the necessity for any scraping, except when large masses of fused ore block the gates—called locally *bolas*.

Round each kiln there is a revolving tray which collects the calcined ore and conveys it to a fixed discharge point. In the battery of kilns 9 to 12 these trays discharge into the buckets of an aerial bucketway. These buckets in turn are discharged from a travelling bridge over the dump. In the battery of kilns 1 to 4 the ore is discharged from the tray through a chute on to a stock heap, where an overhead travelling crane, equipped with a 2-ton Priestman grab, takes the ore and deposits it at any desired point on the heap. At the battery of kilns 5 to 8 the ore is drawn into wheelbarrows and wheeled on gantry platforms to the stock heap.

The stock heap of battery 9 to 12 has a useful surface of 2400 square metres and a height of 3 m., the capacity being about 8000 tons. Battery 1 to 4 has a stock heap 25 m. wide, 50 m. long, and 6 m. high, thus giving a capacity of about 10,000 tons. Before the modifications were made half the ten hours' working day was employed in drawing the kilns, and during the other half they were under blast. Since the modifications each drawing takes eight to ten minutes, *i.e.*, about forty minutes per day, the rest of the time being available for blowing.

At the present time, as the modifications are still in progress, it is impossible to state exactly the number of men necessary for each battery, or the period of most economical blowing. The production before was 60 to 70 tons of calcined ore per kiln per day, and to-day it has risen to 125 to 150 tons per day, *i.e.*, 1·25 to 1·50 tons per cubic metre. In view of the increased output and the consequent difficulty of obtaining ore sufficiently cool to ship, water spraying has been adopted with considerable success. The maximum temperature of ore for shipment is 80 deg. Fah. The coal consumption is about 2·25 per cent. of the calcined ore. The coal used contains 27 per cent. of volatile matter.

Fig. 1 shows a sectional elevation of a kiln and a plan of the hearth.

Every pair of kilns has one fan driven by a 62 horse-power electric motor. The pressure is about 25 cm. of water. These motors also drive the tray and the aerial bucketway. The inclined plane for the crude ore is driven by a 55 horse-power motor. The travelling grab has a 40 horse-power motor for elevating, one 10 horse-power motor for the travelling bridge, and a 5 horse-power motor for the travelling car.

Franco-Belga Company.—This company has adopted a lower type of kiln. It is of elliptical section, formed by two semi-circles of 1·5 m. radius joined by a straight portion 0·56 m. long. Its effective height is 5·85 m. The kilns are built in sets of two. It is proposed to build twenty-four kilns arranged in two parallel lines of six sets each, but at present only four kilns of the second line have been constructed. These four kilns are 60 cm. higher than the others.

The discharge of the kilns is made through two doors placed symmetrically in the short axis. The width of each door is 50 cm. Calcined ore is discharged into a bin of about 10 tons capacity below each set. These bins are discharged through the bottom by means of a mechanical feeder on to an apron conveyor which runs under each line of kilns. Both conveyors discharge into a transverse conveyor which carries the calcined ore to the main line wagons.

The calcined ore is cooled in the general stockyard owned by the company at Requeta, the terminus of its general railway. When it is not desired to load direct into wagons the conveyor can discharge into hopper-bottom tubs which are run over a local stock heap. The crude ore arrives by a cable way, and the buckets pass over the tops of the kilns or can be discharged on to a stock heap.

The blower has a pressure of 12 cm. of water. Each fan blows four batteries and the blast enters from the bottom and passes through the furnace grate which forms the base. The sectional elevation of the company's kiln —Fig. 2—shows both the old and new position of the bottom.

As a result of the modification recently adopted by this company the production has reached 60 tons as compared with 43 tons.

The fuel employed is coke breeze, and the quantity used

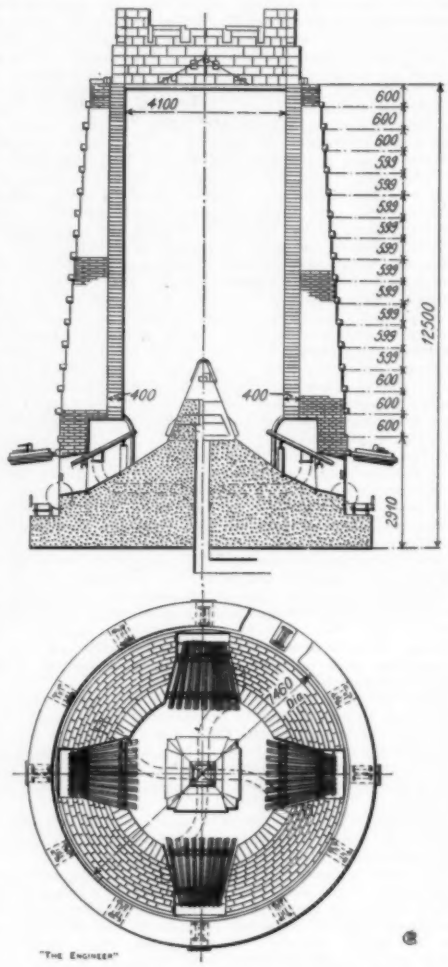


FIG. 1—CALCINING KILN, ORCONERA CO.

is 26 kilos. per ton of crude ore. The kilns work only one eight hours' shift and at each kiln one man is employed for drawing. Only four hours' blowing is done at each kiln, the amount of air being 2 cubic metres per second.

In this manner the production per man/shift is 20 tons. The coal consumption is 36 kilos. per ton calcined, and the

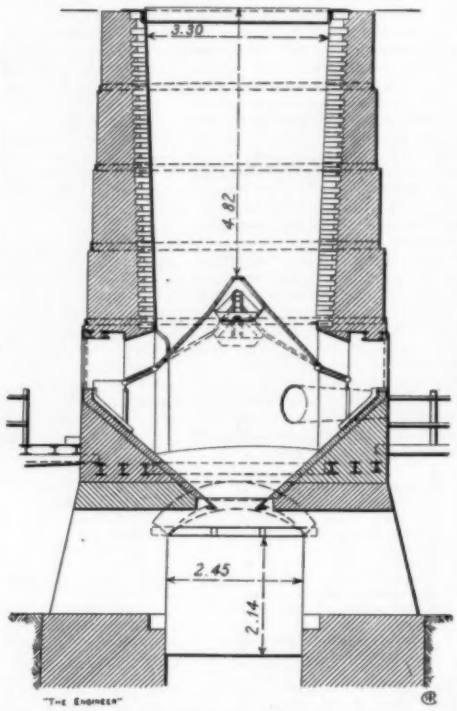


FIG. 2—CALCINING KILN, FRANCO-BELGA CO.

cost for blowing and conveyors about 10 centimos—about 1d.—the cost of energy being 14 centimos per kWhr.

A comparison of this type of kiln with those generally in use in the district shows the advantages of the better handling of materials, less formation of dust in the process of calcination, less difficulty in breaking up the *bolas*. Against these must be set the following disadvantages: less regularity in the drawing due to the number of doors; an increment in the capital cost, due to greater quantity of materials employed per ton produced; and the difficulty of reducing labour, due also to the fact that with two doors it is very difficult to draw all the calcined ore by gravity.

Underground Mining.—Few mines of the district are worked by underground methods. The two principal ones are the Bilbao and the Onton, in both of which the ore is principally spathic. In the first-mentioned mine the extraction is made by adits, and in the second by shaft. In both cases the system employed is the room and pillar method, leaving such pillars as the particular case requires. As a general rule one can put the room at 8 m. and space the pillars at 5 m. to 10 m., according to the roof pressure and the resisting quality of the ore.

The exploitation of the pillars, if carried out at all, is done by allowing them to cave in on retiring and recovering what one can, or, as was done at Luchana, by mining by systematic "sub-level caving," and trying to recover as much of the timber as possible, even at the expense of mixing the ore with the waste, in view of its high price. In general terms it can be said that there is no system characteristic of the district, the exploitation being generally carried out without pilot workings or much system.

The Dicido Company in the neighbouring province also has underground workings, but these are, so far, rather trial workings, with a larger gallery section than usual in order to compensate for the cost.

The yield per man underground is just as high as that in open cast, even taking into consideration that the greater part of the ore is spathic.

Railway Transport.—The most important mining railways in the district are:—

The so-called Triano Railway, from San Julian de Musques to Desierto; single line, standard gauge (1·672 m.).

The Orconera Iron Ore Company's railway, from Gallarta to Luchana; double line, narrow gauge (1·0 m.).

The Franco-Belga Company's railway, from Cadegal (Ortuella) to Requeta (Luchana); single line, narrow gauge (1·0 m.).

The Bilbao River and Cantabrian Railway Company's railway, from Galdames to Sestao; single line, narrow gauge (1·0 m.).

The normal transport tariff in the district is 34 centimos per ton-kilometre (about 4d.).

Actual Conditions of Iron Ore Mining in the Province of Vizcaya.—The mines are distributed to such an extent that the production from each is very small, and much would be gained by general association of neighbouring mines in order to be able to introduce labour-saving devices which for one single mine would not be economical. However, mineowners do not appear inclined to favour general amalgamation, even with their nearest neighbours.

The following table shows the wages paid for work done in the mines.

Average Wages in the Mines, 1927.

	Wage.	Insurance.	Pension.	Tools.	Total.
	Pesetas.	Pesetas.	Pesetas.	Pesetas.	Pesetas.
Foremen	9·74	0·39	0·12	—	10·25
Labourers ..	7·17	0·29	0·12	0·07	7·65
Boys	5·20	0·21	0·12	—	5·53
Drillers	8·125	0·325	0·12	0·10	8·67
Track layers ..	8·065	0·323	0·12	—	8·52
Horse drivers ..	7·27	0·29	0·12	—	7·68
Shunters	7·20	0·29	0·12	—	7·61
Sorters	7·20	0·29	0·12	—	7·61
Blacksmiths ..	9·12	0·36	0·12	And coal 2·20	11·80
Blacksmiths' helpers	7·08	0·28	0·12	—	7·38
Engineers ..	12·00	0·38	0·12	—	12·50
Traffic men ..	9·00	0·36	0·12	—	9·48

For every workman employed in the mines the law enforces the payment of 12 centimos (about 1½d.) per day towards the Workmen's Pensions Fund, and the payments for accidents can be taken at about 4 per cent. of the daily wage.

Insufficient attention has been given to the importance of modern loading methods in Vizcaya. Shipowners, when sending a ship, have from long experience a good knowledge of the conditions at the loading staith at which the ship is to load. The rate of loading is usually guaranteed at 500 tons per working day. If the seller fails to load at this rate he pays demurrage at the rate of 2d. per ton per day on the total ore shipped. It will therefore be understood that a company whose shipping arrangements are well organised is able to save 2d. per ton on the freight. In some of the loading staithes in Santander, where loading is carried out by means of belts working at high speed, thus giving the ship a much quicker despatch, 1s. 5d. is often saved on the freights.

Prospects or Future of Bilbao Mines.—Various boreholes have been made on the eastern slope of the anticline which forms the ore deposit of the Bilbao district, with the idea of proving whether the limestone bed is mineralised or not. These holes were made in the vicinity of the Bilbao-Santander road, between Retuerto and Ortuella, but gave no positive results, in so far as at 500 m. depth the limestone bed had not yet been met, probably owing to the inclination of the strata. Borings were also made on the western side to test the syncline of Sopuerta and Galdames, with the same results.

This limits considerably the possibilities of the Bilbao deposits, likely as it is that the limestone bed would be met at a depth at which it would not pay to exploit it. On the other hand, between the San Miguel and Peñusco Mendiola faults results have been satisfactory, and, although incomplete, the borings allow a fair estimate of large masses of ore at reasonable depths. To the east of these faults and in the vicinity of the Peñusco Mendiola fault no borings have been made, and it is probable that a mineralised bed might here be cut at not too great a depth.

There are other parts of the district with possible ore, where no attempt whatever has yet been made to bore. In other words, the possibilities of Bilbao are still considerable.

The author hesitates to give definite figures for the ore

reserves of the district, but tentatively one may reasonably estimate that present workings show a content of some 65 million tons, of which, say, 40 per cent. is probably spathic.

From borings made in virgin mines one deduces a reserve of some 40 million tons of ore, principally spathic, and a conservative addition of a further 60 million tons in unbored parts of the district may be supposed. These, together with the 200 million tons already extracted in the district, bring the total to 365 million tons when mining operations began.

The future of the district is dependent on the spathic ore. The conditions under which the ore has to be extracted, as compared with Rubio, necessitate a larger consumption of explosives, but this is compensated for by the fact that the faces are much cleaner, and the general conditions favour systematic mechanisation. On the other hand, 40 per cent. more crude spathic ore has to be extracted than the amount of calcined ore obtained, but this also has its compensation in the higher iron content.

Comparing the behaviour of first-class Rubio and first-class spathic in the furnace, it is to be noted that the latter shows higher loss in the flue, and its higher sulphur contents call for a more basic slag. Even taking into consideration these disadvantages, a calculation of the comparative furnace charges seems to indicate that the price of calcined spathic could be 20 per cent. higher than that of the Rubio. This is not the case to-day, but it is to be supposed that, as time goes on, prices will be stabilised and that the relation of the price of calcined to the Rubio price may reach the above percentage. Already one begins to observe an increased demand for calcined spathic. In the above comparison the calcined spathic has been assumed to have no further treatment and to be used alone. In practice this is not feasible, but the ore sinters very well, and if submitted to this treatment it could be used as the principal ore. If, for instance, 40 per cent. of it were submitted to sintering, the sulphur content could be reduced to, say, 0·28 per cent. The surcharge of 2 pesetas per ton incurred by this treatment is balanced by the reduction in sulphur contents and of flue losses.

CATALOGUES.

ALFRED HERBERT, Ltd., Coventry.—"The Book of the 'Coventry' Diehead."

VIOZONE, Ltd., 19, Cursitor-street, London, E.C. 4.—Folder, entitled "Breathe Fresh Air by Viozone."

WILLIAM GEIPEL, Ltd., 156, Bermondsey-street, S.E. 1.—A copy of the firm's steam trap catalogue.

HANS RENOLD, Ltd., Didsbury, Manchester.—Price list of Renold chains for industrial applications and cutting.

BROOK MOTORS, Ltd., Empress Works, Huddersfield.—List No. 204 of single, two and three-phase electric motors.

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—The sixth edition of "The Weir Closed-circuit Feed System for Marine Work."

STURTEVANT ENGINEERING COMPANY, 147, Queen Victoria-street, E.C. 4.—Publication No. 1432, "Gasworks Equipment."

JAMES KEITH AND BLACKMAN COMPANY, Ltd., 27, Farringdon-avenue, E.C. 4.—Booklet K81 on induced draught and flue dust arresting.

TANGYES Ltd., Cornwall Works, Birmingham.—Booklet No. 355, illustrating various Tangye plants installed in different parts of the world.

R. A. LISTER AND CO., Ltd., Dursley.—Particulars of the company's new "auto-truck" for use in factories and on wharves, stations, &c.

B.E.N. PATENTS, Ltd., 92, Tottenham Court-road, W. 1.—A loose-leaf catalogue of B.E.N. equipment and supplies for engineering and automobile industries.

RUTHS STEAM STORAGE, Ltd., Africa House, Kingsway, W.C. 2.—Pamphlets on Ruths steam accumulators in relation to smoke abatement and the storage of steam.

STROMBERG MOTOR DEVICES, Ltd., Milman's-street and Cheyne-walk, Chelsea, S.W. 10.—Latest retail price list of Stromberg carburetters and other accessories.

THE WELLINGTON CHAMBER OF COMMERCE, New Zealand.—Commercial and Professional Directory. Wellington: New Zealand. Published by the Chamber of Commerce.

HATHORN, DAVEY AND CO., Ltd., Sun Foundry, Dewsbury-road, Leeds.—Particulars of the "Stereophagus" pump for unscreened sewage, sludge, trade effluents, semi-pastes, &c.

MCGRAW HILL PUBLISHING COMPANY, Ltd., 6, Bouverie-street, E.C. 4.—List No. 12. McGraw-Hill books on "Transportation," including aeronautic, automobile, marine, and railway engineering.

THE ROTHERMEL CORPORATION, Ltd., 24, Maddox-street, W. 1.—A booklet introducing the Buckeye Company's portable "Hercules" air tools, which are being handled in this country by the Rothermel Corporation.

BRITISH-THOMSON-HOUSTON COMPANY, Ltd., Rugby.—Pamphlet entitled "An Air-jet Cooled Power Transformer," being a description of the B.T.H. 8350 kVA power transformers recently installed in the Longford Power Station of the Coventry Corporation.

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), Ltd., 136, Victoria-street, S.W. 1.—A sixty-page brochure illustrating and describing the Woodall-Duckham plants for the treatment of coke, coal, and by-products.

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.—The session 1928-29 opens at University College on Monday, October 1st. Students of the Faculty of Engineering will be received by the Provost and the Dean between 10 a.m. and 1 p.m. on Monday and Tuesday, October 1st and 2nd. Further laboratory accommodation is being provided. Among the public lectures that have been arranged for the first term are the following: A course of five lectures on "High-tension Transmission of Power," by Mr. Percy Dunsheath, of the Research Department, W. T. Henley's Telegraph Company; on Tuesdays at 6.30 p.m., beginning November 13th; three lectures on "Historical Factors of the Problem of London Traffic," by Miss E. Jeffries Davis, on Thursdays, October 11th, 18th, and 25th, at 5.30 p.m.; three lectures on "Smoke Pollution of the Air and Public Health," by Dr. John Owens, on Fridays, November 2nd and 9th, and Wednesday, November 14th, at 5.30 p.m., Sir Napier Shaw presiding at the first lecture; "The British Coal Industry," by Mr. W. L. Cook, Conciliation Officer and Assistant Labour Advisor to the Secretary for Mines, on Friday, November 9th, at 5.30 p.m.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Continued Progress.

THE iron and steel and engineering industries of the Midlands and Staffordshire continue to make progress. True, it is not rapid, but nevertheless it is appreciable, and appears moreover to be well founded. The volume of trade is broadening, especially in the steel branch and the market tone is taking on a firmer and more hopeful character. Industrialists are encouraged to hope for better times, and are keenly watching for opportunities to increase their business. Prices of materials have in some instances turned upward, and though supplies in every branch are adequate to meet current demands, it is felt that in the near future we may hear of increased activity at the works producing raw and finished material.

Steel.

Business in the steel industry is gradually but surely gaining impetus, and the outlook is considerably brighter than it was. Continental competition becomes less effective each week as values appreciate, and owing to the recent decision of the International Steel Cartel, to adhere to its present production programme for next year, continental prices are likely to remain on their present relatively high level. Native mills are securing an increasing percentage of the available business, and while it is a fact that in some branches of the trade little headway is being made against the recent dull conditions, in others mills are much better circumstanced than they have been before at any time this year with regard to orders and employment. Especially is this applicable to the rollers of small bars. In this department of the market the upward trend of continental prices has been accentuated this week by a sharp rise. Quotations f.o.b. Antwerp make the price here £7 5s., in some cases more. Native makers price was at the time £7 7s. 6d., and being on the spot and able to guarantee delivery, they were able to clinch practically all the business which came along. Indeed their position has become so strong that they have been enabled to take indemnification for the higher cost of their raw material by increasing quotations 2s. 6d. per ton. For British bars £7 10s. to £7 15s. is now asked according to size and character of order. Slow appreciation continues in other departments of the continental market, and local steelworks are finding more work. For some time past German mills have been seeking business in this country, but they are no longer offering billets. Despite the increased imports last month, Birmingham merchants find that hardly any foreign material is coming into this district. Deliveries are very slow, and with one or two exceptions, prices do not offer any advantage when carriage charges from the port to this district are added. Constructional engineers have good order books, though there is nothing of a particularly bulky nature amongst the contracts being booked. All the work is taken at finely-cut prices. The mills producing joists and sections are fairly busy, but the plate mills are still very short of work. Native billets sell well at from £6 2s. 6d. to £6 5s. Steel values, except those enumerated above, are unchanged from last week.

Raw Iron.

The demand for Midland pig iron is slowly expanding, but orders are on a limited scale, and are little more than sufficient to absorb the output of the small number of furnaces operating in this district. Instances of consumers desirous of buying more than small parcels of pig iron are few. In a few cases consumers and merchants are stated to have booked supplies as an insurance against a possible rise in pig iron prices, but they intimate to producers that they do not want delivery yet awhile. There has been some drawing upon stocks at furnaces during the past fortnight, but there are very heavy accumulations to be cleared before any addition to the ironmaking plant can be considered. Prices remain on the recent levels of £3 for Derbyshire, £2 15s. 6d. for Northampton, and £3 2s. 6d. for North Staffordshire. Some special brands of hematite from South Wales and a little Scotch iron are finding their way to Midland works. Birmingham merchants report a few more orders being given out by foundries though contracting forward is avoided in practically every case. There is very little shading of prices at the moment, smelters being unwilling to make the concessions they formerly made to secure business.

Finished Iron.

The Staffordshire finished iron trade continues its uneven course. Some of the marked bar mills report a slight improvement in trade due to the placing of orders by railway companies, but the absence of other business of any bulk is causing much concern. The heavy trades of Staffordshire have improved very little, but the increased activity in the shipyards is calculated to bring some benefit. One firm engaged in the production of engineering tools has some good business on hand for the Belfast yards. Marked bar prices remain at £12 per ton, a figure at which they have stood for a considerable time. In the merchant and common branches of the industry mills are but moderately employed, and makers appear to be fighting a losing battle against the foreigner. In the Crown bar department internal competition has also to be contended with. Prices of Crown iron vary from £9 10s. to £10 in Staffordshire, but these are undercut by makers in Lancashire and Derbyshire, who sell at from £9 2s. 6d. to £9 7s. 6d. Belgian No. 3 iron bars for the bolt and nut trade cost £7 2s. 6d. delivered in the Black Country, and Staffordshire ironmakers contend that they cannot sell their nut and bolt iron at £8 15s. to £9 with such a difference between the home and foreign rates. Demand has fallen off somewhat for wrought iron gas tube strip, but values are maintained at £10 15s. upwards.

Galvanised Sheets.

In the galvanised sheet trade most mills have good orders. Indeed the output of some of the mills is reported to have been sold up to December. Manufacturers who can give early delivery are able to command a better price than £13 10s., which is the figure generally quoted for 24-gauge corrugated sheets. Prices are very firm, and in some cases are as high as £13 15s. A good deal of inquiry is in the market, and the returns for last month show a sharp recovery in exports, advancing to 65,546 tons after the poor showing of July.

Tin-plate.

The agreement reached between Welsh and American tin-plate interests as to the appointment of the trade outside the two countries has not stimulated demand in this district, where wasters are selling but slowly at the 16s. 9d. basis. To what extent the ambitious scheme for eliminating competition between the two principal producing countries may contribute towards the restoration of Welsh tin-plate industry as an economic whole remains to be seen.

Imports Query.

It is a rather remarkable state of affairs and one much commented upon in Birmingham this week that while local importing merchants have for months past been asserting that the demand for foreign iron and steel has almost vanished, owing to the advance in continental prices and the long date of deliveries, the Board of Trade returns record an increase of imports of these materials during August, amounting to 53,411 tons over the preceding month. Manufacturers agree that though foreign material still enters largely into some of our Midland manufactures, the tonnage brought into the district is nothing like as large as formerly. Reports from other industrial centres have been to the effect that local iron and steel producers are reaping the benefit of the absence of, or lessened continental competition. Where then is all this foreign material going? An increase of nearly 25 per cent. over the preceding month wants some accounting for. It is noticed that increases were shown in almost every class of finished material and half-products. Steel blooms, billets and slabs went up from 45,327 tons to 52,093 tons; iron bars, rods, angles, shapes and sections, from 13,703 tons to 18,502 tons; steel sheet bars and tin-plate bars from 43,169 tons to 54,005 tons; wire rods from 10,947 tons to 12,312 tons; steel girders, beams, joists, and pillars from 12,326 tons to 20,076 tons; plates and sheets from 10,970 tons to 17,530 tons. While there was a further decline in the quantity of foreign forge and foundry pig iron landed at our ports, more basic pig was received.

Improving Coal Outlook.

During the past few weeks the outlook in the coal trade in the Midlands has improved. A proportion of the collieries in this area are now making full time. The new impetus to business has been provided, however, almost entirely by domestic requirements. There has been very little quickening of the industrial demand, notwithstanding the augmented seasonal requirements for heating and lighting purposes. The pits in the Warwickshire coalfield as a result of the lowering of the minimum rate of wages, where the pits were not paying, from 43 to 32 per cent., are now in a position to benefit by any revival of demand which may develop. It may be mentioned that the rate of pay for underground men in these collieries will now be 7s. 9d. per shift and for surface workers 6s. 10½d. per shift. The averting of the threatened closing down of Warwickshire collieries is a course for much satisfaction, and the amicable temper which has made this possible is to be commended. The miners' leaders had the facts and figures before them, and realised that the case was desperate. They recommended their followers to submit to a revision. This the rank and file agreed to do, and there is no question of their loyal acceptance of the reduction which has been made. The pits at which readjustments of the percentage have been made are the Tamworth Colliery, the Newdigate Colliery, the Exhall Colliery, the Binley Colliery, Coventry and Pooley Hall.

Shropshire Electricity Scheme.

Now that the Wellington Urban Council has revoked its Electric Lighting Order, obtained over twenty years ago, the West Midland Electricity Authority will be able to go forward with its scheme for providing the Wellington area and other districts with electricity for power and lighting without further delay. It is hoped that a start will be made with the erection of the new power station at Ironbridge, formal sanction for the construction of which has recently been given, by the end of the year.

Inexpensive Fuelling.

In view of the present interest in experiments and developments of motor engines for road transport which run on inexpensive brands of crude oil, it is instructive to know that a Wolverhampton firm has, for some time been manufacturing for export a commercial lorry which also dispenses with petrol—except for starting up from cold—and derives its power from a self-contained gas producing plant that burns charcoal. This vehicle, the product of Guy Motors, Ltd., has emerged completely from the experimental stage, and is now a standard overseas model. So successful has the charcoal-burning Guy proved, that for the past eight months these vehicles have been supplied to various purchasers in Africa, Australia and South America, and repeat orders received by Guy Motors, Ltd., prove that their solution of the Colonial petrol problem is a satisfactory one.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Works Committees in Engineering.

AN interesting discussion as to the value of works committees in industry, with special reference to engineering shops, arose in the course of the annual conference

of the Institute of Industrial Welfare Workers, held here from Friday last to Monday of this week. During a Sunday afternoon session devoted to a consideration of the works committee movement in industry, Mr. Sam Ratcliffe, who is chairman of the works committee at the Trafford Park works of the Metropolitan-Vickers Electrical Company, Ltd., discussed the position from the point of view of the engineering industry. No works committee, he urged, should be set up if from the workmen's side it was not based on a trade union qualification. Mr. Ratcliffe admitted that in many industries it might not be easy to follow that out; but, he said, unless those on the works committee were sufficiently versed in the varying agreements and policies of trade unions they would probably find themselves in difficult circumstances. Mr. C. G. Renold, of Hans Renold, Ltd., Manchester, who presided over this session, expressed the opinion that the kernel of the works committee movement was that it should be used to get financial information across to the workers. Since 1921 his own firm had been showing the whole of the accounts to a committee of workers, and there had been astounding progress in the education of the members of that committee, who could now read balance-sheets and discuss technical problems in a manner which they could not possibly have done two or three years ago.

Industrial Hygiene.

The progress of factory legislation and the development of industrial hygiene were discussed by Dr. Stallybrass, Liverpool's assistant medical officer of health, at a special session concerned with health in industry. The high mortality rate of tin miners and cutlery grinders, he said, was due to the silica dust arising from their work. In the case of cutlery grinders, the replacement of gritstone wheels by carborundum wheels had resulted in a definite improvement in the conditions. Dr. Dearden, medical officer for the Port of Manchester Authorities, said that apart from poisonous fumes, conditions of temperature, humidity, and lighting had much to do with the ill-health resulting from indoor employment.

Accident Prevention in Mines.

Mr. A. D. Nicholson's report for 1927 on mining inspection under the Coal Mines Act in Lancashire and North Wales division refers at some length to the causes and prevention of accidents. During the year 106,100 people were employed in the raising of coal in the division, the output being 20,500,000 tons. The percentage of fatal accidents due to roof and side falls—56·8—was much the same as in previous years. In order to reduce this class of accident, the increased use of bars instead of props and lids at the face and edges of rippings is recommended by Mr. Nicholson, who also states that the use of steel arch supports in Lancashire mines has proved very satisfactory. Two cases of fire-damp ignition, both caused by sparking from an electrical coal-cutting machine, and both pointing to faulty maintenance of the machine, occurred during the year.

Contracts Going Abroad.

Salford City Council, at an adjourned meeting, has passed a resolution of protest "against the action of the Government in placing with a foreign firm a contract for telephone wire and so taking a step calculated to increase unemployment in this country." This would seem to indicate a definite change of policy, for on several occasions during the past two years extensive contracts for cable for the Council's electrical undertaking have been placed with continental—mainly Dutch—concerns.

Increasing Motor Car Production.

The directors of Willys-Overland Crossley, Ltd., it has been announced during the past few days, contemplate increasing the output of motor cars at their Heaton Moor (Manchester) Works from twenty to 100 a day, providing employment for about 2000 additional men.

Locomotive Exhibition for Charity.

An interesting exhibition of locomotives, staged for Saturday and Sunday next (September 29th and 30th), the proceeds of which will be in aid of Manchester and Salford hospitals, has been organised by Beyer, Peacock and Co., Ltd., of Gorton, Manchester. Four engines are to be exhibited, comprising an articulated engine for the Kenya-Uganda Railway, a Ljungstrom turbine engine recently used on the L.M.S. Railway, an engine and tender for the Great Eastern section of the L. and N.E. Railway, and a Garratt locomotive, fitted for oil-burning, for the Chilean Nitrate Railways. The last mentioned locomotive, which is 80ft. in length over the buffers, is said to be the largest articulated engine ever made in this country. It has a water capacity of 5500 gallons and an oil fuel capacity of 1410 gallons.

Liverpool–Belfast Air Mail.

An experimental mail service from Liverpool to Belfast, operated by a "Calcutta" flying-boat, is being run this week. In the first flight the "Calcutta" flew the 145 miles between the two ports in 105 minutes. The official time-table provides for the "Calcutta" leaving Rock Ferry Pier, Liverpool, at 9.45 a.m., and Liverpool moorings at 10 a.m., arriving at Belfast quay at noon. The return trip from Belfast starts at 2.45 p.m., the flying-boat reaching the Liverpool moorings at 4.45 p.m., and Rock Ferry Pier at 5 p.m.

Obituary.

Mr. Frederick Freidenthal, head of the engineering firm of Freidenthals, Ltd., Preston, and a director of the Lytham Shipbuilding Company, died at Preston on Tuesday of this week at the age of seventy-nine years. Before starting in business on his own account Mr. Freidenthal was for many years managing director of Stevensons, Ltd., engineers, of Preston.

Non-ferrous Metals.

The past week's operations on the non-ferrous metals markets have been notable for substantial rises in both copper and tin. The demand for the former has been on an improved scale, and a further advance in the refined metal has been accompanied by an increase in standard brands which brings current values of these to a higher level than has been experienced for a considerable period, and with the expanding world consumption accounting for the current output continued firmness may be expected. Tin, also, with a rise of between £8 and £9 a ton on the week is dearer than it has been since the beginning of June. Here, again, the demand from consumers of the metal, both in this country and abroad, is improving, and the statistical position in this section of the market may be regarded as stronger than it has been for some time. In view of past experience of price movements in the case of tin, however, it would hardly be wise to place too much reliance on a continued advance. Foreign lead has lost ground a little, but English metal has been about maintained at the level current a week ago, and a moderate business has been done. With regard to spelter, there has been a further easing off and buying interest has been of somewhat limited extent.

Iron and Steel.

Midland pig iron producers continue to meet with gradually improving conditions on this market, although up to the present there has been no appreciable broadening of the demand for other varieties of foundry iron. During the past week a not unsatisfactory inquiry has been reported, and more consumers appear to be covering themselves for forward deliveries. Under the circumstances, although quotations are no better than before, the tone of the market remains steady, with Derbyshire and Staffordshire brands at from 67s. to 67s. 6d. per ton; Middlesbrough at 79s.; Scottish at 87s. 6d. to 90s.; and hematite at 81s. 6d., all delivered into this area. In the case of steel, a moderate business is passing in constructional varieties, and in boiler-plates and bars at generally firm prices, sections being quoted at £7 17s. 6d., general plates at £8 12s. 6d., boiler-plates at £9 10s. to £9 15s.; large bars at £8 17s. 6d.; and small re-rolled sorts at £7 17s. 6d. Imported steels are strong, although only a quiet section of the market, with steel bars dearer at £7 5s. to £7 7s. 6d. per ton; joists at about £7 2s. 6d.; Siemens plates at £8 5s.; wire rods at £6 17s. 6d.; sheet bars at £5 15s.; billets at £5 14s.; and bar iron at £7 2s. 6d. for cash against shipping documents, and including delivery to Lancashire works.

BARROW-IN-FURNESS.

Hematite.

The condition of the hematite pig iron trade is better than it has been for months. The demand for iron has increased, and there is a more promising feeling as regards inquiries. It has taken a long time for the trade of this district to change for the better, but everything seems to point to improved business all round. The output of the district is now being practically dealt with, and there is no longer much chance of stocks accumulating; in fact, it is possible that there will be a welcome diminution. Continental business leaves room for improvement, but there are a few inquiries. As for American business this may improve in the early future, but the trade is spasmodic. The local ore trade is about the same, but there are chances of outside demands improving in view of the better state of the iron trade generally. Until there are more furnaces put in blast the local demand will remain about the same. The steel trade is quiet and fresh orders are needed if the mills are to be kept working after October. Barrow rail and merchant mills are employed, and the hoop works are assured of a steady run. There have been exports of hoop wire to Galveston recently.

Chilian Submarines.

The first of the Chilian submarines being built at Vickers-Armstrongs naval construction works at Barrow, the "Captain O'Brien," will be launched next Tuesday. The other two vessels will be put into the water very shortly. These submarines are similar to the British "O" class.

SHEFFIELD.

(From our own Correspondent.)

Good Demand for Basic Steel.

THE basic steel trade of Sheffield and district, which has suffered great depression for several years, is now one of the bright spots of local industry. It has been greatly hit by continental competition, but this handicap is disappearing, owing to the higher prices in foreign countries. Steel users are consequently placing large orders at home, where they can get material of more reliable quality coupled with better delivery and financial terms. Rollers of cheap steel in this country have advanced their quotations by fully 7s. 6d. per ton, and even at this price they can compete with the foreigner. One of the establishments to benefit by the altered state of things is the large basic steel plant of the United Steel Companies at Templeborough, which is experiencing an improved demand for the softer qualities of basic billets and slabs. North Lincolnshire is also reaping considerable advantage, for the same reason. It is reported that the Redbourne Hill Works, at Scunthorpe, are contemplating the early installation of tin-plate mills. These works stood idle for four years, but a portion has just been restarted, and one or two of the steel furnaces are to be gassed early in December. When the works were in full swing, the bulk of their output was rolled into tin-plate bars, and then sent to South Wales to be rolled down and converted into tin-plates.

Acid and Other Steels.

The situation on the Continent has not had any effect upon high-quality acid steels, the making of which is one of Sheffield's principal lines. For months there has been but a poor demand, not only for these, but also for the higher carbon basic steels. Trade has not yet begun to expand, and the proportion of idle acid furnaces in the city to-day is larger than that of basic. Among consumers who buy billets for working up, an increasing number are using the cheaper raw materials. The continued restriction of specifications by the British railway companies is another cause of the depression in this branch. A good railway order announced last week was one secured by the Leeds Forge Company—which is controlled by Cammell Laird and Co., Ltd., of Sheffield—for 400 steel drop-sided bogie wagons for the South African Railways. The value of the contract is £177,600. The general position as regards ordinary competitive lines shows no improvement, but, as several centres of the steel industry report increased sales and inquiries, there is a feeling of hopefulness with regard to the future. In certain special lines, good business continues to be done, these including hollow forged drums for high-pressure boilers, steel balls and machines for crushing minerals, and stainless steel for many purposes. A shortage of work is reported by the mills and forges. There is some improvement in the call for bar iron. In the tool steel departments, speaking generally, conditions are quiet, but a few makers are booking a moderate amount of business. Only a few of the engineering foundries are busy, and there is much quietness at the light iron foundries.

Lighter Industries.

The file branch is depressed, and many of its workers are on short time. There are a large number of orders on hand, but most of them are for small quantities. The threatened increase of the Spanish duties on these tools is causing much anxiety, though there is yet no official confirmation of the report. There is a good demand for twist drills of the best qualities, but slackness is pretty general in regard to saws, edge tools, farm tools, and plantation tools. The cutlery makers have been expecting an autumn revival of buying, but only a few of them have experienced it so far, and with the majority business is flat and unremunerative. There are, however, several large contracts on hand, for ship and hotel furnishing, and also for penknives to be distributed for advertising purposes. There has for some time been a pronounced falling off in the sales of penknives through the ordinary shop-keeping channels. The production of stainless table knives of the cheaper sorts, spoons and forks, and small cased goods, continues on a large scale. Orders from the Dominions are increasing, in anticipation of the Christmas season trade.

World's Heaviest Steel Casting.

The fact that Sheffield leads in the steel world has again been demonstrated by the making of a mammoth casting, which is stated to be the heaviest ever produced by any firm, either in Sheffield or abroad. It was made by Cammell Laird and Co., Ltd., at their Grimesthorpe works, for Firth-Derihon Stampings, Ltd., of Carbrook, and forms the anvil block for a 5-ton friction drop stamp designed by B. and S. Massey and Co., Ltd., of Manchester. Made of comparatively soft, plain carbon steel, the original casting weighed 140 tons, and the weight after machining is 95 tons. The dimensions are:—Height, 6ft. 1in.; block base, 9ft. 2in. by 10ft. 2in. Machined holes of an average depth of 2ft. 6in. pierce the sides of the block, and vary from 5in. to 7½in. in diameter. The casting was described as quite abnormal, in that it was made of steel, previous blocks having been of iron. It has proved such a great success that Messrs. Firth-Derihon has now given Messrs. Cammell Laird an order for a 40-ton anvil block, which is now in course of manufacture.

A Large Filtration Plant.

Sheffield last week brought into use the second instalment of its great plant for filtering the water which it receives from the undertaking of the Derwent Valley Water Board. The object of the filtration is not purification, but merely clarification, the water being naturally of excellent quality. Sheffield's share of the Derwent Valley water is 7,500,000 gallons daily, and in 1913 it erected plant at the Rivelin filter station to deal with 3,500,000 gallons. The second instalment of the installation is, therefore, rather larger than the first. The new plant comprises:—(*a*) Chemical preparing and measuring equipment for the application to the water of suitable doses of reagent for coagulating the impurities, for the removal of the colour, and for neutralising the acidity, complete with suitable pumps for adding these reagents to the water; (*b*) thirty-two pressure filter units, each 8ft. in diameter, giving a total filtering area of 1600 square feet. These filters are all connected to a common raw water inlet main and to a pure water outlet main, and are arranged to be cleansed by compressed air, each filter being independently connected to an air main for this purpose; (*c*) engine-driven rotary blowers for providing the compressed air for the filter-cleansing operation. The general contractors for the new station were Abbott and Bannister, Ltd., of Sheffield, and the filtration plant was provided and installed by the Paterson Engineering Company, Ltd., of London.

Goole's Water Extensions.

The town of Goole is now entitled to congratulate itself on having made provision for its water supply for the next half-century. Not long ago I reported that it was erecting a water tower, the largest of its kind in Europe, with a holding capacity of 750,000 gallons. The tower is now completed, and an extension scheme has also been carried out which includes a new bore-hole, a new set of triple-expansion marine type pumping engines, and a pump house. The bore-hole is 603ft. deep and 36in. in diameter, and draws water from a great natural reservoir in a bed of red sandstone. The pumping capacity of the new works is 56,000 gallons per hour. The extensions have cost £52,375, and have been carried out by Hathorn, Davey and Co., Ltd., and Messrs. H. Arnold and Son.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Shipbuilding Orders.

RECENT orders placed on the North-East Coast for vessels of special design have augmented the work in hand to a considerable extent, but it is probable that, when the present quarter ends, figures will show that there is less tonnage under construction than there was three months ago. The larger yards are well supplied with contracts for the winter, but the smaller establishments are eagerly on the look-out for work. Tramp tonnage is still in small demand, but it is an encouraging sign that laid-up boats are decreasing on the Northern rivers. Two Wear shipbuilding firms have been fortunate enough to secure new orders this week. Bartram and Sons, Ltd., are to build a 10,000-ton cargo steamer for East Coast owners; and Short Brothers, Ltd., have orders from Common Brothers, Ltd., Newcastle, to build a steamer of 10,500 tons deadweight carrying capacity. Both ships are to be engined by John Dickinson and Sons, Ltd., Sunderland. The Northumberland Shipbuilding Company, Ltd., has secured an order from the Court Line, Ltd., London, for a 9000 tons vessel, which will be fitted with Diesel oil engines by Doxford and Sons, Ltd., Sunderland. This is to be a similar vessel to that ordered last month by the same owners from a Wear firm. An order for an ice-breaker has also been placed with Smith's Dock Company, Ltd., Middlesbrough.

Cleveland Iron Trade.

The past few days have brought a seasonal expansion of the demand for Cleveland pig iron, but, while merchants are finding a fair amount of business afoot, requirements are not in excess of the normal for the period of the year, and in one or two directions where sales were anticipated nothing substantial has materialised up to the present. Still, the limited quantity of iron available for disposal in the open market is well taken up, notwithstanding continued keen competition for orders by Midland firms, who are considerably undercelling the products of this area. Fairly large quantities of Northamptonshire pig iron and Lincolnshire basic are reaching the district by rail and sea respectively. Cleveland pig iron makers' fixed prices are unchanged, No. 1 foundry being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

Business on both home and continental account is showing a gratifying expansion in the East Coast hematite trade, and stocks have become inconveniently small. Quotations are steadily moving up, but producers still complain that they are unprofitable. About 70s. is now the general quotation, which is only 4s. above the price of No. 3 Cleveland, whereas in pre-war time the normal difference was 8s. to 10s.

Ironmaking Materials.

Little new business is reported in the foreign ore trade, but deliveries against old contracts are heavier. Market rates remain on the basis of best Rubio at 22s. 6d. c.i.f. Tees. Durham blast-furnace coke is selling only moderately for local consumption, but producers are not pressing supplies on the market. Good average qualities keep in the neighbourhood of 17s. 6d. delivered to works in this district.

Manufactured Iron and Steel.

Works engaged on the production of finished iron and steel are more actively employed. Further orders for vessels promise to hasten distribution of specifications for shipbuilding requisites. Rail manufacturers are fairly well placed, and steel for constructional engineering is in rather good request. Sheet producers are heavily sold to the end of the year. Some improvement in manufactured iron is noticeable, and transactions in semi-finished steel are expanding a little. Quotations all round are steady.

The Coal Trade.

Coal exporters in the North of England are passing through a difficult period for want of tonnage, and as a result there is a steadily accumulating volume of orders for all descriptions of coal. The want of suitable steamers has continued for weeks, but behind the demand for them there is really no robust strength, as has been shown now and then when a few boats have come on the market at one time. In such circumstances, the rates ease immediately, and, when the tonnage against becomes scarce, there is a renewed firming up. The present difficult position may last well through October and until the Baltic timber season closes. For weeks past steamers have been going to the Baltic in ballast rather than risk discharging delays or miss homeward freights, and this has had its effect on the general supply of boats for coal cargoes. The Northumberland steam coal position continues encouraging. There is more inquiry about, and the collieries producing best qualities are full or orders for the next two weeks. The rest of the pits are not doing badly, and dearth of steamers is their chief anxiety. Steam smalls are moving off well, so that the outlook is more cheering than it has been of late. Best Northumberland steams are at a minimum of 13s. 6d., with second qualities at 12s., while prime smalls are quoted at from 9s. 3d. to 9s. 6d. Apart from steam coal business, the Durham collieries are having an anxious time for new business. The seasonal demand for gas fuel has not yet set in, and trade in this fuel is quiet. Another dull section is coking coals, which are plentiful and easy in price. Best Durham gas coal is quoted at 14s. 9d., and secondary kinds at 13s. 3d. to 13s. 6d. The market for patent oven cokes continues to show a steady demand, and makers are well sold, and are in a good position for the whole of next month. Tonnage on hand is below requirements, but is sufficient to give a firm tone to the export market. Good brands are holding steadily to a minimum of 18s. 6d. to 19s. Beehive coke and special foundry qualities are steady at 23s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Slow Progress.

GENERAL conditions in the steel, iron and coal trades show little or no change on the week. Here and there better export inquiries are reported, and producers view the hardening tendency of continental prices with hopefulness, but actual bookings of new business are still far below the output capacity of the steel or iron works or the restricted output of the collieries.

Steel.

Inquiries for steel are moderate, but bookings of heavy material are rather fewer than recently, the output of shipbuilding material in particular having fallen off. Sectional material is not well placed. Steel sheets are comparatively busy, more especially in the lighter gauges. Prices for black and galvanised sheets are steady, but producers are endeavouring to secure increased prices in view of the dearer costs of raw materials. Galvanised corrugated sheets are nominally £13 12s. 6d. per ton f.o.b. for 24-gauge and requirements are steady.

Iron.

Bar iron is unchanged in price, but demands are very limited. Re-rolled steel is better off than bar iron, but even in this department the output is not particularly satisfactory, though the mills are employed with fair regularity. Pig iron shows no improvement, and the market is dull with prices unchanged. Only some twenty-one furnaces are in operation, but outputs are more than sufficient to meet all demands.

Scrap.

Demands for scrap metals are moderate, and supplies are evidently ample, but prices are steady at 65s. per ton for heavy steel and 62s. 6d. per ton for cast iron.

Exports and Imports.

During the past week imports of iron ore at Glasgow Harbour only totalled 3600 tons. Imports of steel and iron totalled 1800 tons, and 1400 tons of pig iron were also unloaded. Exports during the same period included 2400 tons of steel and iron products, and 849 tons of pig iron

Coal.

The position in the coal trade cannot be termed otherwise than unsatisfactory. The scheme to improve the industry through limitation of outputs has succeeded in so far that prices have maintained a more or less steady level, but the actual turnover has not been improved. Meanwhile household fuels are in no better demand than during the summer months, and efforts to secure an increase in prices have met with little or no success so far. Merchants, however, anticipate a change for the better next month. Foreign demands also are below expectations, and in this connection business with Scandinavian countries is especially disappointing. The feature of the shipping market is the continued scarcity and firmness of washed nuts, especially Lanarkshire materials. Lanarkshire collieries, owing to a lack of shipping tonnage, have quantities of best splints for disposal. Ells, however, are scarce, and firm round about 15s. 6d. per ton f.o.b. Glasgow. Lothians steams are a trifle dull. Fifeshire best steams have improved, and stocks of these coals will be further diminished by commitments under contracts for the Finnish State Railways, deliveries of which are almost due. Third-class Fifeshire steams are well booked for a week or two ahead.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

To all outward appearances there has been no change in the general conditions prevailing in the coal industry of this district during the past week. From the shipowner's point of view, things have certainly been better, as although outward rates of freight have not touched the highest level of 1927, they have advanced from 6d. to 1s. 3d. per ton for Mediterranean and South American destinations, and even in the short trades rates have improved to some extent compared with a week or ten days ago. There has been a continued shortage of tonnage, and this has, of course, proved detrimental to the interests of the collieries. This shortage has been experienced for some weeks now, and it naturally follows that work at the docks and the pits has been on a reduced scale. Some improvement in the general situation has been looked for of late, but colliery salesmen have for the most part been disappointed. Even when a fair amount of tonnage has come along it has scarcely made any impression, as so much coal has been standing that cargoes have in most instances been loaded in quite good time, with the result that no pressure of any account has been noticeable, and the daily record of idle tipping appliances has been fairly high. The return of shipments from South Wales ports last week marked an improvement, as the total reached over 460,000 tons, compared with just over 400,000 tons the previous week, yet at the end of last week there were as many as thirty-three idle tipping appliances at the various docks. This week has not started any too well as, notwithstanding fresh arrivals of steamers, there were on Monday twenty-three vacant loading berths. Nevertheless, there is some hope of an improvement shortly, as for the week ended the 21st inst. the amount of tonnage chartered to load in this district came to over 350,000 tons, which was over 70,000 tons more than for the preceding week; the total, in fact, being the highest for any week since the end of June last. If only this figure can be maintained, there is a decided prospect of loading activity displaying a substantial improvement; but unfortunately the experience of the past year has shown that any burst of activity has been short-lived. Still, the foreign inquiry does show signs of slight expansion.

Coal Exports to Spain.

In the last year or so much has been heard of attempts on the part of Spanish mineowners to restrict the imports of foreign coals, and the Spanish Government has certainly aided them to a considerable extent. Numerous restrictions have been imposed, and it would appear as if scarcely a month has passed but what some new condition has been imposed, making it increasingly difficult for coals to be exported from this country to Spain. At the end of last week news was received that the Spanish mineowners are making a further attempt to secure protection, their complaint being that all native industries except theirs have the protection of Customs duties. It is likely that when the new Customs tariff comes to be discussed, they will bring all the pressure possible to secure that there should be an extension of the duties to coal imports or that the law of 1926 which compels the consumption of Spanish coal should be rigidly imposed. As a matter of fact, it would be quite easy to show that the Spanish mineowners are already pretty well protected; but, notwithstanding this, they are unable to hold their own. For Spain to continue, however, the policy of restricting coal imports, means that Spanish exporters of iron ore, wines, &c., will become very perturbed, as the one is bound to react very seriously on the other.

Tin-plate Trade.

It is now reported that the agreement between South Wales manufacturers of tin-plates and American producers for a division of the export trade comes into operation on Monday next, October 1st, and is to be in force for a period of three years. The agreement provides for a division of the export tin-plate markets of the world in the proportion of 30 per cent. for the United States and 70 per cent. for this country. The Elba Steel Works, Gowerton, is reported to be engaged on special orders for tin bars for export to Burma. The business is not of an extensive character, but will provide work for about three weeks. The point, however, is that this is the first time that such a contract has been secured, as the order has previously gone to the Continent. The hope is entertained that further orders will follow.

Current Business.

The general tone of the market remains without any new feature. The inquiry for coals is a shade better, but the volume of business is not sufficient to have any perceptible effect upon the market. There are still many undertakings that are not working regularly, and with coals in excess of requirements there is no definte improvement in values. Sized coals are quite firm, owing to the good demand and the limited quantities available, but there is no change in large qualities. The demand for patent fuel is very quiet. Pitwood is firm and quoted at 30s., the reason for the rise being that news has been received that the men engaged in the unloading of coal and the loading of pitwood at Bordeaux have struck work for an increase in wages.

LAUNCHES AND TRIAL TRIPS.

RUSHPOOL, steel screw cargo steamer; built by the Cowper Dry Docks and Shipbuilding Company, Ltd., to the order of the Pool Shipping Company, Ltd.; dimensions, length, 435ft.; breadth, 54ft.; 9000 tons deadweight. Engines, triple-expansion; constructed by Blair and Co. (1926), Ltd.; trial trip, September 19th.

KERMA, steel screw cargo steamer; built by David and William Henderson and Co., Ltd., to the order of F. G. Strick and Co., Ltd.; dimensions, length, 370ft.; breadth, 52ft. 3in.; depth, 28ft. 3in.; gross tonnage 4350 tons. Engines, triple-expansion, 24½in., 41in. and 66in. diameter by 45in. stroke; pressure 180 lb. per square inch; trial trip, September 20th.

CIUDAD DEL SALTA, twin-screw passenger and cargo vessel; built by Harland and Wolff, Ltd., to the order of the Argentine Navigation Company, Ltd.; dimensions, length, 250ft; breadth, 42ft.; depth, 11ft. 6in. Engines, two six-cylinder trunk piston engines; trial trip, September 21st.

MAKASSER, motor ship; built by The "De Maas" S.B. Company, Slikkerveer, to the order of the Royal Packet Company, of Amsterdam; dimensions, 165ft. by 28ft. 8in. by 10ft.; 400 tons deadweight. Engines, one Sulzer 250 horse-power motor, to give a speed of 8½ knots; launch, September 22nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

JOHN WILKES, SONS AND MAPPLEBECK, Ltd., have removed their London office to 10, Mayfair-place, Berkeley-street, W.1.

SIR WESTCOTT ABELL is taking up his duties as Professor of Naval Architecture at Armstrong College, Newcastle-on-Tyne, on October 1st next. He is giving up his London office at 101, Leadenhall-street, at the end of the month, and his address in Newcastle will be 14, Westfield Drive, Gosforth, Newcastle-on-Tyne.

THE partnership between Mr. J. J. Guthrie and Mr. W. J. F. Brugess, trading as J. B. Guthrie and Son, is being dissolved, by mutual consent, as from September 29th. Mr. J. J. Guthrie will continue to trade as J. B. Guthrie and Son, at 30, St. Mary-axe, E.C. 3, and Mr. W. J. F. Burgess as W. J. F. Burgess and Co., at 6, Broad-street-place, E.C. 2.

THE AC-SPHINX SPARKING PLUG COMPANY, LTD., Bradford-street, Birmingham, informs us of the appointment of Mr. N. F. Stockbridge as managing director, to succeed Mr. W. A. Clark, who has retired from the management after many years service. The new managing director was previously assistant general manager of the Associated British Machine Tool Makers, Ltd., London.

MR. GILBERT P. NORTON informs us that, as receiver and manager under the Court, he has disposed of the assets of the Campbell Gas Engine Company, Ltd., and the business has now been handed over to the purchasers. George Cohen, Sons and Co., Ltd., inform us that, as purchasers of the assets of the company, they hold themselves responsible for the payment for all goods ordered by Mr. Norton or on his behalf.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	18 6 to 21/6
(1) Spanish	18 6 to 22/6
(1) N. African	18 6 to 22 6
N.E Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos	3 10 0	3 10 0
No. 1	3 11 0	3 11 0
Cleveland—		
No. 1	3 8 6	3 8 6
Siliceous Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 6 to 2 17 6	—
Forge	2 12 6	—
(3) Derbyshire—		
No. 3 Foundry	2 19 0 to 3 0 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	2 19 0	—
No. 4 Forge	2 17 6	—
Basic	2 19 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 4 6 (b) / 4 8 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G.)	13 10 0	13 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 17 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands—		
Small Rolled Bars	7 10 0 to 8 0 0	—
Billets and Sheet Bars	6 2 6 to 6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Toes	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/1½ to 18/4½
Block Tin (cash)	223 10 0
,, (three months)	219 0 0
Copper (cash)	64 12 6
,, (three months)	65 5 0
Spanish Lead (cash)	21 13 9
,, (three months)	21 8 9
Spelter (cash)	24 6 3
,, (three months)	24 8 9
Manchester—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	72 0 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	33 10 0
,, Foreign	22 0 0
Spelter	24 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/7 per lb.
Ferro Tungsten	1/3 per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£37 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£41 0 0	17/-
,, ,, ,, carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home	
	£13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/- per lb.	
,, Molybdenum	4/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	15/6
,, ,, Splint	16/- to 17/-
,, ,, Trebles	13/3
,, ,, Doubles	13/-
,, ,, Singles	12/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/- to 12/9
Screened Navigation	18/-
Trebles	14/- to 15/6
Doubles	13/3 to 13/6
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/3 to 12/6
Secondary Steam	11/9
Trebles	14/-
Doubles	13/3
Singles	12/6

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/-
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	18/3 to 19/-
Sheffield—	Inland.
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	21/- to 22/6 —
Best House Coal	19/6 to 20/6 —
Screened House Coal	16/- to 17/- —
,, ,, Nuts	14/- to 16/- —
Yorkshire Hards	14/6 to 16/- —
Derbyshire Hards	14/6 to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	4/6 to 6/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/-
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/- to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/-
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	16/6 to 18/6
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/- to 36/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/6 to 21/6
Pitwood (ex ship)	31/6 to 32/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 27/6
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	35/- to 43/6
Beans	23/6 to 26/-
Peas	18/- to 18/6
Breaker Duff	8/- to 8/3
Rubbly Culm	11/- to 11/3
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Steel Trade.

THE decision of the Steel Union to make no change in the production during the last quarter of the year was taken against the desire of the French to increase the output in view of the improved prospects arising out of the larger demand which is expected from the execution of the number of public works that are to be put in hand shortly. Home consumers fear that this activity will cause a further advance in prices, and the Government is therefore being exhorted to spread the orders over a sufficiently long period to prevent inflation. It is, of course, to the interest of steelmakers to secure higher prices at home in order to recoup themselves for the low prices at which they are selling steel abroad, and it is some testimony to the influence of the Cartel that it should have succeeded in its policy of stabilising prices to the extent that, while French steelmakers did not insist upon their demand for an increased production, they deem it prudent to keep prices on the home market at the present level.

Diesel-electric Locomotives.

On the railways in North Africa there is some drawback to the use of steam locomotives, especially in those parts of the country where the supply of water is wholly deficient, and of late years trials have been carried out with internal-combustion engines in the hope that they would simplify the service and allow of economies being realised. So far, the best results have been obtained by the Tunis railways with a Sulzer locomotive supplied by the Compagnie de Construction Mécanique. The locomotive is of 1 metre gauge, and has an eight-cylinder Diesel engine of 250 horse-power, with a generator supplying current at 400 volts to four motors. The motors can be coupled up in pairs either in series or in parallel. The economy and flexibility of this system of traction under conditions for which steam locomotives are not entirely suitable are stated to be sufficiently pronounced to justify the belief that the Diesel electric locomotive will be employed extensively in the future in North Africa.

Road and Rail Transport.

The railway companies are offering to carry motor cars at specially reduced rates for owners travelling by the same train, so that they may be able to start their tours in any part of the country. It is now proposed to adopt a similar arrangement in the case of motor delivery vans which are employed by all the big commercial firms for delivering goods over wide areas. The railway companies cannot deal with this traffic because the commercial houses deliver against payment and take back goods that customers find are unsuitable, and this, of course, can only be done by their own organisation; but as heavily laden vans have to travel over-night for distances of 100 miles and more to towns where deliveries have to be effected the railway companies believe that they can save the commercial firms some of the cost of making long journeys with heavy loads and returning empty by running fast trains during the night with trucks for the vans and a coach for the men accompanying them. Some means must be found of rapidly loading vans on to the trucks and of unloading them at the various destinations, and this at present offers some difficulty on account of the low platforms at all the French railway stations. It is believed that this difficulty will be overcome and that, by making a fixed charge for the van and a graduated charge for the load, it will be possible to carry them at less cost than by road and with less fatigue to the men.

New Railways.

On the return of Alsace to France the Government decided to undertake immediately the construction of railways in addition to the existing Nancy-Strasburg and Belfort-Mulhouse lines, which flank the two ends of the Vosges, and are insufficient for communication between France and the restored province. Plans were made for constructing two railways through the Vosges, one from Saint-Dié to Saales, and the other from Saint-Maurice to Wisserling, but owing to the latter scheme requiring a costly tunnel, it has not yet been possible to start upon its construction. The Saint-Dié-Saales line was begun by the military authorities immediately after the Armistice with a single track, and in 1920 the construction of the railway was officially authorised, when the line was re-surveyed for a double track railway. It is now completed, and will be inaugurated during October. The length of the railway is 15 miles. Although passing through a mountainous region the line does not offer any technical difficulties, but there are several interesting works, such as the curved Lubine Tunnel 1 mile long, with a continuous radius of 800 m. Of far more technical interest is the line from Nice to Coni, in Italy, which will be officially inaugurated shortly. Over the greater part of the distance it constitutes an almost continuous series of arches, viaducts and tunnels, some of the constructions being of particularly bold design. The railway is intended to put Nice into direct communication with Turin, while a branch line runs to Vintimiglia, but owing to its passing through four different sections of French and Italian territory, there is some complication in arranging for local traffic, although the express service from Nice to Turin is direct. It is found that on account of the international conventions providing for stoppages at frontiers and changes of trains from one section to another considerable time is lost to local traffic in the valley of the Roya.

Foreign Trade.

The returns of foreign trade show a widening margin of imports over exports, the value of goods imported during the first eight months of the year being 34,539 million francs, and of exports 33,360 million francs. Notwithstanding a small diminution in the quantity of "material necessary for industry" imported the value underwent an appreciable increase. The coal imports declined by more than 1,100,000 tons. The exports of "material necessary for industry," including iron and steel, amounted to 22,692,879 tons, an increase of 2,320,044 tons, and the value declined by 2518 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

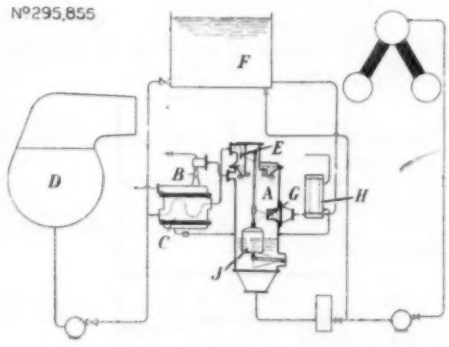
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

295,855. October 5th, 1927.—DE-AERATING FEED WATER, G. and J. Weir, Ltd., Cathcart, Glasgow.

In the preamble to this specification it is pointed out that the usual practice is to return the condensate from a condenser to an open feed tank and there to add the necessary make-up water, with the result that the condensate re-absorbs atmospheric air, and the whole has to be de-aerated before it is returned to the

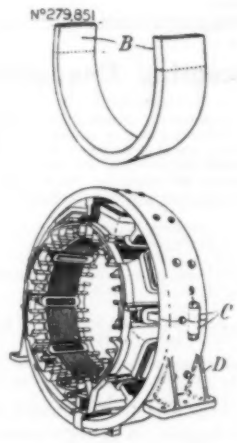


boiler. The de-aerator is shown at A. Within it a vacuum is maintained by the ejector B, which works in conjunction with an auxiliary condenser C. The condensate from the main condenser D passes through C and is delivered into the top of the de-aerator through a valve E. Make-up feed water is drawn from the tank F and is delivered to the de-aerator through the valve G, having first been heated at H. The valves E and G are controlled by the float J.—*August 23rd*, 1928.

DYNAMOS AND MOTORS.

279,851. October 25th, 1927.—IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF BUILT-UP STEEL FIELD RINGS FOR DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

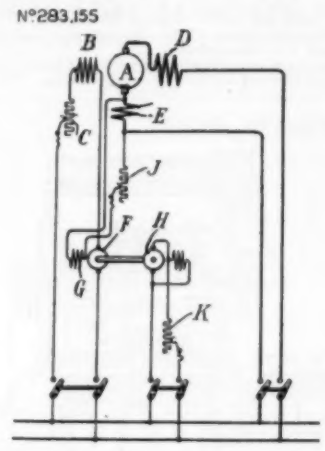
Field rings of dynamo-electric machines are constructed in accordance with this invention from steel slabs which are bent to the desired curvature by passing them through bending



rolls, and the ends are joined to form a ring. The slab is first uniformly heated in a furnace to a forging temperature and then passed through the rolls, which not only bend the slab to the desired shape, but also smooth out irregularities on the surface. After the rolling operation the unbent ends B of the two sections are cut off at the points indicated by the dotted line. The lugs C and feet D are welded to the frame.—*August 23rd*, 1928.

283,155. January 5th, 1927.—IMPROVEMENTS IN AND RELATING TO ELECTRIC MOTOR CONTROL SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.

An object of this invention is to provide an improved arrangement whereby the speed regulation of an adjustable-speed motor may be automatically maintained as small as possible at all operating speeds, or whereby the percentage speed change from no load to full load for different operating speeds may be automatically maintained substantially the same. The system described comprises an adjustable speed direct-current motor A having a shunt field winding B with an adjustable rheostat C in circuit for varying the motor speed. The motor is also equipped with a series field winding D which is wound so that the ampère turns of the series field, when the motor is running in the normal direction, assist the ampère turns on the shunt field winding in maintaining the field flux. The motor is also provided with a commutating field winding E. A source of voltage introduced in series with the shunt field winding is shown as a direct-current generator or exciter F having a field winding G. This exciter is driven at approximately constant speed by means of a constant-speed motor H. A rheostat K is connected in series with the armature circuit of the motor H to adjust the speed of the constant-speed device. The field winding G of the exciter is connected across the terminals of the commutating field winding E so that the field winding G is excited by a current which is proportional to the load current of the main motor A. An adjustable rheostat J is connected in circuit with the field winding G to afford a means for adjusting the effect of exciter F. The armature of the exciter F is connected in series with the shunt field winding B of the main motor in such a way that when current is flowing in the normal direction in the arma-

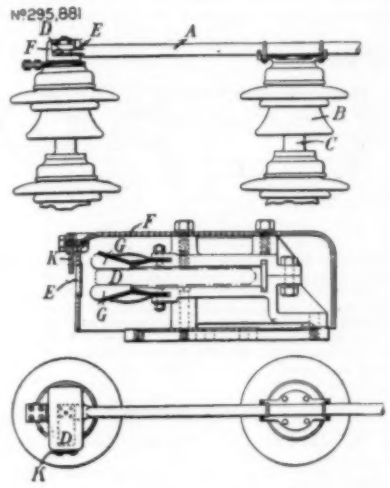


ture of the main motor, and consequently through the field G of the exciter, the exciter voltage will be in opposition to the voltage of the main shunt field; that is, it will tend to reduce the voltage actually applied to the motor field, and, consequently reduce the shunt field current. A long explanation is given of the method of operation.—*August 23rd*, 1928.

SWITCHGEAR.

295,881. November 30th, 1927.—IMPROVEMENTS IN AND CONNECTED WITH ELECTRIC SWITCHES, The English Electric Company, Ltd., of 28, Kingsway, London, W.C. 2; and Alfred Reginald Blandford.

The contacts of switches situated in the open may be exposed to adverse atmospheric influences especially if they are arranged horizontally. They may be covered with ice and snow or with fine particles of sand or other material. According to this invention, at one end the moving blade A is fixed by a bracket at the top of an insulator B attached to a spindle C which is fixed

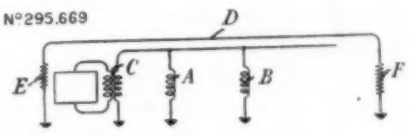


at the top of another insulator. The bracket and insulator B can be rotated through 90 deg. so that the arm A and its blade D can swing in a horizontal plane. When the arm is in the position shown the moving blade enters the slot E in the side of the walls of the box F and engages with the spring-supported contacts G. As the moving blade D passes through the slot E into the box its horizontal surface is swept by the lower part of the wiper K composed of fabric. Suitable materials for the wiper are fabrics which are used as linings for the friction surfaces of brakes and clutches.—*August 23rd*, 1928.

TELEGRAPHS AND TELEPHONES.

295,669. May 17th, 1927.—AN ARRANGEMENT FOR COUPLING CARRIER WAVE SIGNALLING APPARATUS TO A TRANSMISSION LINE, Standard Telephones and Cables, Ltd., of Connaught House, Aldwych, London, W.C. 2.

The object of this invention is to improve the efficiency of a coupling between carrier apparatus and transmission lines. In accordance with the invention the impedance to earth of the coupling line or antenna for the carrier frequencies employed is increased by connecting additional impedances between this



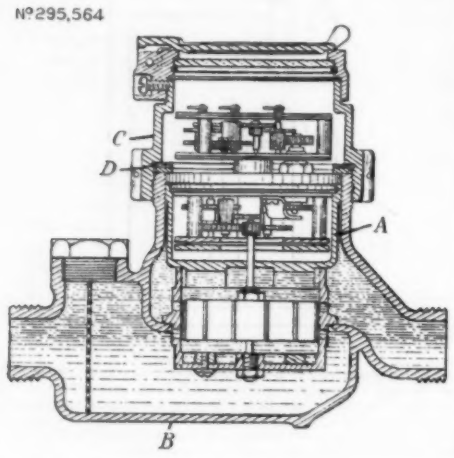
line and earth. In the diagram the additional impedances are shown at A and B, the spacing of these impedances being determined by the frequency employed. For an ordinary short coupling wire one or two coils are sufficient. The idea is to make the critical frequency of the loading the same as the critical frequency of the carrier apparatus. The carrier apparatus is connected to the coupling wire through a transformer C, and the carrier current is transmitted to the power line D in the case illustrated by electrostatic induction. The power line is shown terminating at the sending end in an impedance E of the trans-

former which supplies the power wire. At the distant end there is another impedance F, which becomes a pure resistance at carrier frequencies. There are four other illustrations.—*August 17th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

295,564. April 5th, 1928.—WATER METERS, A. L. Guilmant, The Grange, Dalton Parva, Rotherham; and Guest and Chrimes, Ltd., Rotherham.

The object of this invention is to prevent a water meter being damaged by freezing of the water it contains. The working

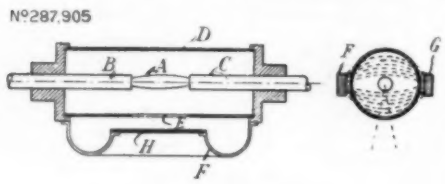


part A of the meter is held in the main casing B by means of the screwed cap C and the annular washer D. This washer is of copper and is grooved to provide a definite zone of weakness. Should the water in the meter freeze this washer is sheared through and the internal pressure is relieved.—*August 16th*, 1928.

LIGHTING AND HEATING.

287,905. March 26th, 1928.—IMPROVEMENTS IN ARC LIGHTS, Körting and Mathiesen, Aktiengesellschaft, of 2, Flemmingstrasse, Leipzig-Leutzsch, Germany.

The arc light A is formed between two electrodes B and C and is surrounded by a cylindrical shade D composed of sheet metal. The rays from the arc are emitted through the aperture E. At the sides of the arc two magnets F and G are provided and they



counteract the tendency for the arc to move upwards. The high temperature produced by the arc causes the air to ascend. If the containing enclosure is tightly closed no air will be admitted through the slot E and the arc will therefore retain the properties of one burning in a closed space, although the light rays can escape through the slot E. A receptacle F is provided for the reception of the glowing particles thrown off by the arc and a filter is provided at H.—*August 16th*, 1928.

METALLURGY.

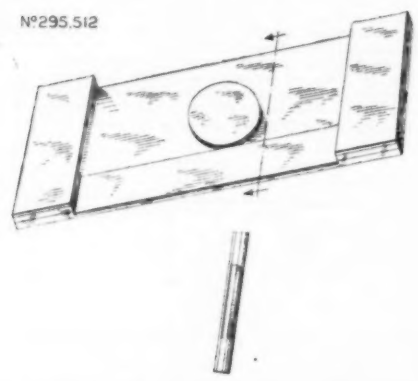
295,857. October 11th, 1927.—WROUGHT IRON, *H. Wade*, 111, *Hatton-garden, London, E.C.* 1.

The inventors propose to add to commercial wrought iron about 0·25 per cent. of nickel and about 1 per cent. each of copper, chromium and molybdenum. Such a metal, they say, has the following characteristics:—Ultimate tensile strength, 50,000–60,000 lb. per square inch; yield point, 25,000–35,000 lb. per square inch; resistance to impact, over 40 foot-pounds; fatigue limit, over 25,000 lb. per square inch. The process of incorporating the nickel is described.—*August 23rd*, 1928.

MISCELLANEOUS.

295,512. August 20th, 1927.—DISC TESTING DEVICES, The London Electric Railway Company, 55, Broadway, Westminster; and W. S. Every, Vanbrugh Cottage, Vanbrugh-road, Bedford Park, London, W. 4.

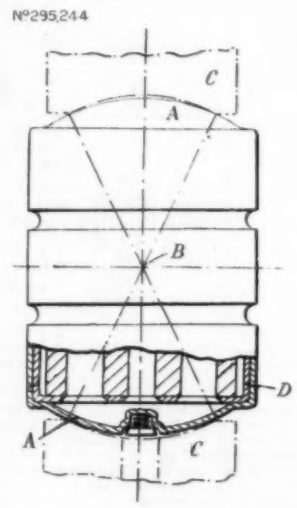
This device is put forward as being specially applicable to the



testing of coins inserted in automatic vending machines; but it might be used for various other purposes. It comprises a chute along which the discs are to run edgewise, the base of which chute is very narrow and open along one edge, while along its other edge is an upstanding wall of the chute sloped laterally out of the vertical in the direction to assist in supporting the discs while the latter are resting upon the base of the chute. Thus, if the disc is flat and undamaged on the edge, it will pass through the chute and be accepted, but if the disc is bent or has a chipped or pinched edge, it will, sooner or later, fail to engage with the narrow base of the chute and will slip off over the open edge of the latter. In a coin-operated vending machine such coins as pass the test travel on into other parts of the machine for further testing, or for operating the machine, but such as slip over the edge of the base of the chute may be returned to the exterior of the machine.—*August 16th*, 1928.

295,244. May 5th, 1927.—IMPROVEMENTS IN AND CONNECTED WITH ELECTRIC FUSES OF THE CARTRIDGE TYPE, The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2; and Arthur Milnes Pooley, of 73, Warwick-avenue, Bedford.

The two outer ends of the cartridge are formed as spherically shaped sheet metal caps A and so that their centres of curvature are situated approximately at the point B which is the middle of the length of the cartridge. This permits a certain amount of variation in the position of the cartridge when inserted between the spherically shaped engaging contact members C without material disturbance of the effectiveness of the engagement. The radius of the caps A should be slightly greater than that of



the contact members C with which they engage, so that engagement takes place on a belt around the edges, thus giving the self-centring end pressure distributing effect. The difference in radii should preferably be such that there is no actual contact between the members A and C at the centre under appropriate pressures. In view of the slight change of shape in the cartridge end caps A which takes place under the engaging pressure, and in order to avoid producing local stiff parts in the ends, it is desirable to provide a second sheet metal cap D inside each of the spherical caps A and to connect these inner caps with the outer caps A only around the edges as shown. These inner caps D are then utilised for the attachment of the ordinary fuse wires.—*August 7th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Goole, to commence with lunch at the Station Hotel, Goole, at 12.30 p.m.

MONDAY, SEPTEMBER 24TH, TO SATURDAY, OCTOBER 6TH.

WORLD POWER CONFERENCE.—Fuel Conference. Imperial Institute. For programme see page 719, June 29th.

FRIDAY AND SATURDAY, SEPTEMBER 28TH AND 29TH.

THE FARADAY SOCIETY.—A general discussion on "Homogeneous Catalysis," to be held in the Physical Chemistry Laboratory of the University of Cambridge.

MONDAY, OCTOBER 1ST.

BRADFORD ENGINEERING SOCIETY.—Hall of Bradford Technical College. "A Survey of Modern Textile Machinery," by Mr. H. Unwin. A film will be exhibited, depicting the manufacture and erection of the "Royal Scot" locomotive. 7.30 p.m.

CHEMICAL ENGINEERING GROUP.—In the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Road Surfacing Materials," by Mr. W. J. A. Butterfield. 8 p.m.

THE SOCIETY OF ENGINEERS (INC.).—Burlington House, W. "Pulverised Fuel in Theory and Practice," by Dr. G. E. K. Blythe, Ph.D., &c. 6 p.m.

THE STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Education Offices, Dudley. Presidential address by Mr. P. Jump. 7 p.m.

TUESDAY, OCTOBER 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, York-buildings, W.C. 2. Presidential address by Mr. L. H. Hounsfield, entitled "The Integrity of the Technical Man." 8 p.m.

THURSDAY, OCTOBER 4TH.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—Visit to the Penpoll Tin Smelting Company's works Bootle. Motor omnibus leaves Engineers' Club, Manchester, at 1 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Scottish District meeting at Kilmarnock. Meeting at Kilmarnock Town Hall. 10.45 a.m.

ROYAL AERONAUTICAL SOCIETY.—At the House of the Royal Society of Arts, John street, Adelphi, W.C. 2. "The Technical Development of the Aeroplane," by Mr. J. D. North. 6.30 p.m.

FRIDAY, OCTOBER 5TH.

CHEMICAL ENGINEERING GROUP.—In the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Factory Floors," by Mr. F. Heron Rogers. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Lecture, "Interesting Details of Swiss Alpine Railways," by A. J. Simpson (Member). Illustrated by special slides. 7.30 p.m.

SATURDAY, OCTOBER 6TH.

ELECTRICAL POWER ENGINEERS' ASSOCIATION: SOUTHERN DIVISION.—Hotel Cecil, Strand, W.C. 2. The tenth annual dinner to the members of the National Executive Council, at 5.30 for 6 p.m. Tickets, 7s. 6d., may be obtained from P. Gordon Hieatt, hon. secretary, Southern Division, 25, Parkhurst-road, Bowes Park, N. 22.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Joint meeting of the South Wales District and the Institution of Civil Engineers (South Wales Association), to be held at Cardiff. Assemble at the City Hall, Cardiff, 10.15 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Western District Meeting at Stockport. Assemble at Stockport Town Hall at 11 a.m.

MONDAY, OCTOBER 8TH.

THE INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Mr. S. E. Flack. Chairman's address. 7.30 p.m.

TUESDAY, OCTOBER 9TH.

THE INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address by Dr. J. A. Smyths. 7.30 p.m.

WEDNESDAY, OCTOBER 10TH.

THE INSTITUTE OF FUEL.—At the Chemical Society's Rooms, Burlington House, Piccadilly, W. 1. Mr. T. A. Peebles, of Pittsburgh, will read a paper on "Automatic Combustion Control of Liquid, Solid and Gaseous Fuels." 6 p.m.

THE INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—In the Thomas Café, High-street, Swansea. Chairman's address by J. H. Grant. 7 p.m.

THURSDAY, OCTOBER 11TH.

THE INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. Chairman's address by Dr. S. W. Smith. 7.30 p.m.

FRIDAY, OCTOBER 12TH.

DIESEL ENGINE USERS ASSOCIATION.—19, Cadogan-gardens, S.W. 13. "Marine Oil Engines," by Mr. Sterry B. Freeman. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Ordinary Meeting. Paper, "The Use of Instruments in the Boiler-house," by F. Squirrell (Member). Slides. 7.30 p.m.

THE INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-Ferrous Section, Applied Science Department of the University, St. George's-square, Sheffield. "Alternating Current Electrolysis," by R. D. Barklie; "Sodium Cyanide in Silver Plating," by Dr. E. E. Sanigar. 7.30 p.m.

MONDAY, OCTOBER 15TH.

THE INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Conjoint meeting in the Non-Ferrous Section, Applied Science Department of the University, St. George's-square, Sheffield. Sorby Lecture, "Influence of Pressure on Rocks and Metals." by Mr. Cosmo Johns. 7.30 p.m.

THURSDAY, OCTOBER 18TH.

THE INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Engineer's Club, Waterloo-street, Birmingham. 7 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Light Alloys and Their Use in Aircraft," by Mr. H. Sutton. 6.30 p.m.

CONTRACTS.

THE ADEN PORT TRUSTEES have placed a contract with K. L. Kalis, Sons and Co., Ltd., dredging and reclamation contractors, Stone House, Bishopsgate, London, E.C. 2, for the improvement of the entrance channel at Aden, and the extension of the inner harbour. The work will be begun about the middle of December this year, and will be completed in about 3½ years.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., have secured contracts for the construction of eleven broad-gauge, superheated main line locomotives and tenders for the Madras and Southern Mahratta Railway Company, and thirty-two large superheated locomotive boilers for the Bengal-Nagpur Railway Company, together with other locomotive accessories. Other contracts recently secured by the firm include locomotives for the Trinidad Railways, locomotive boilers for the Cordoba Central Railway, and a quantity of locomotive spares for various home and foreign railways. These contracts will be carried out at the Scotswood Works, Newcastle-on-Tyne, and the locomotives will be shipped in the fully erected condition in accordance with the firm's usual practice.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received from the Bradford Corporation a repeat order for a 30,000 kW turbine unit which will embody the latest features of the company's multi-cylinder design. It will be generally similar to a unit of the same output now under construction for the West Ham Corporation. Another repeat order for a two-cylinder turbo-alternator set has just been entrusted to the same company by Edward Lloyd, Ltd., newsprint manufacturers. Like the first machine installed by Messrs. Lloyd in their Kemsley Power House, the new set will be of 12,500 kW and will run at 3000 r.p.m. The extent to which multi-cylinder machines are now being adopted is indicated by the fact that within the past few months new units of this design have been started up at Peterborough and at Huddersfield, while a 25,000 kW unit is under construction for Leicester; all these turbines are of English Electric manufacture. Where the steam plant has to satisfy certain special conditions such as arise in industrial service, it is not always appropriate to sub-divide the steam end. A particularly interesting case is that of the two 10,000 kW sets recently ordered by the State Electricity Commission of Victoria for the Yallourn briquetting plant. The original plant was steam driven but the new extensions are being designed for the electrical driving of the presses, utilising exhaust steam from the turbines for drying out the brown coal before it is pressed; there will be a large surplus of electrical energy which will be fed into the public mains. The turbines, which will be of the English Electric Company's impulse type running at 3000 r.p.m., will operate at a steam pressure of 565 lb./square inch, with a total temperature of 750 deg. Fah., and will supply steam for drying at a pressure of 55 lb./square inch. No fewer than twenty-five tenders were submitted for the plant, including seven from continental manufacturers. The total value of the contracts referred to above is about £250,000.